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THE USE OF ELECTRICITY.

Practically all the central stations are to-day endeavoring to increase in every way their output, and they are trying particularly to increase the load at those times of the day when the load for lighting is least. To aid in this there are many electrical appliances which bring comfort to the home or assist in work at the office, and there are many ways being tried of bringing these appliances to the attention of the electricity-using public. There has, indeed, been a considerable increase in the use of such appliances, but there is room for a still larger increase. No effort should be spared to push the sale of any such device, provided, of course, its service to the purchaser will be satisfactory. Further, encouragement should be given to those who are developing such electrically operated devices, because there can be no doubt that this agent is going to become a still more important factor in carrying out the work in the home and out of it.

Another phase of this increasing use of electric power is the guiding of the public in its proper application. Its use should not be urged when it is obvious that it will not prove satisfactory, and the company should see to it that such power as is used is not used in an ill-advised way. It, of course, may frequently not be advisable to do more than offer a suggestion, but certainly it is to the best interests of both to do the work that is to be done in the most satisfactory manner. This is particularly true in the field of lighting, which has heretofore received so little attention; in fact, it was generally thought that the only thing to be done was to provide a sufficient amount of light, and the amount generally was decided in an arbitrary manner. To-day we know a good deal more about this than we did a year or so ago; in fact the matter has been deemed of sufficient importance to warrant the organization of a special society to study illuminating problems. The electric lighting industries are, it is true, concerned mainly with the production and distribution of electrical energy for lighting, and at first sight it may seem of little consequence to them whether this be used intelligently or otherwise; but a second thought should make it clear that the success of the system depends upon the service given; and the service which is given, or, at least, that part of it which the consumer is aware of, is illumination. If his lighting is not satisfactory, if it is fatiguing or uncomfortable, he, of course, blames the central station; if his bills are large, he is apt to believe that the charges are not right, and again the central station gets the blame. Not infrequently the only trouble is the manner in which the lighting has been arranged. In such cases the lighting company should be able to point out the cause

of the poor service, and it should be able to suggest how it might be improved. While it may not be advisable for the company to undertake to lay out the illumination for each and every consumer, it should, at least, be able and prepared to defend its own system from the consequences of the faults of others. True, the company is only selling current, but it is also true that the consumer wants to purchase light; he cares nothing about the current, except when he pays for it. Therefore, the lighting company should at least be interested in the manner in which its commodity is being used, even though it may have nothing to do with this. Frequently a good deal of trouble might be avoided by a suggestion made at the proper moment. There is no need to seek trouble, and, on the other hand, it is just as bad to let trouble grow for want of a word in time.

ELECTRIFICATION OF STEAM RAILROADS.

Certainly, one of the most interesting engineering problems now being studied is that of applying the electric motor to steam railroad operation. The work has been well started on a number of important roads, and every electrical engineer believes that this application will go on at an increasing rate. But although the first application of an electric locomotive to this service was made over ten years ago, the reasons for doing this have, in each case, been peculiar, and each problem has been solved on its own merits, so that there can not be said to be any standard practice. There are, as is well known, several systems, some of which have been in use for a number of years. Each of these has its own advantages, which, to those who have developed it, seem of very great importance, and are thought to outweigh the admitted disadvantages of that particular system. In this country but two systems have come into any prominence, and both of these are now being put to very thorough trial. Naturally, therefore, every one is looking for as much information as he can obtain respecting the relative merits of these two systems; and the interest is deeper, since there are a number of other important changes to electricity being planned, in which the decision upon the system to be adopted will doubtless be considerably influenced by the success of the first equipments put into service.

This interest is well shown by the number of discussions appearing in the scientific press, and by the various papers on the subject presented before the engineering societies. These have been particularly numerous of late, yet it seems to be unfortunately true that most of these discussions are confined to representing opinions frequently expressed before, and but little new information is given. No complaint should be made if any one proves to his own satisfaction that one system is better than another; nor should any criticism be made if he warmly upholds it; but it does seem as though these recent discussions have been of little value. Nothing has been proved one way or the other; no new facts have been presented which will influence those upon whom a decision for one system or the other may rest in the near future; and it does not seem as if the work of electrification had been in any way advanced by them. Of course, it is always wise to look upon the problem from as many sides as possible; to obtain as many opinions upon them from those competent to express them as can be had. But it can hardly be said that any new light has been thrown upon this problem recently.

There is another feature in the situation which is somewhat disappointing. Some time ago it was announced that one of the large electrical companies had developed a high-potential, direct-current traction motor which would bring the advantages of a high-tension system without losing the good qualities of the direct-current motor. Since then we have been waiting for more information respecting this interesting and promising machine. More recently the same company announced that it had a new alternating-current motor which was better than anything it had heretofore seen. It is unfortunate that the engineers of this company were not able to give more definite descriptions of this new motor; for if it is all that they intimated, it will become an important factor in railway development. It is to be hoped that further information respecting this highly desirable motor will shortly be forthcoming.

It has been proposed recently that certain features of electrification be adopted as standard, but it is hard to see how this can be done safely if newer types of motor are to be brought out every little while.

POWER FOR ELECTROLYTIC PROCESSES.

On several occasions the importance of cheap power for electrolytic processes has been discussed before the American Electrochemical Society. In certain of these processes the cost of power in large quantities is a controlling factor, so that it becomes necessary for such works to be placed near cheap sources of supply. But the field of electrochemistry is spreading and growing rapidly, and the necessity of looking ahead and planning for cheap power is becoming more and more pressing. With a view to solving this problem, it was suggested about a year ago by Mr. E. A. Sperry that certain electrochemical industries, particularly those which require intermittent power, might be operated in conjunction with the electrical supply systems, drawing their power when the load on the stations is low, completing the process, and shutting off when the evening load comes on. This problem is of great importance, not only to the electrochemical industries, but to the electrical supply companies, because, as was stated by Mr. Sperry recently, only about twenty-six per cent of the generating equipment of the power stations in this country is in continuous use; seventy-four per cent is standing idle. Any way of increasing the load-factor by finding an outlet for this unsold power would benefit every one concerned. It would bring additional income to the station; it would lessen the cost of generating power by improving the operating conditions; it would lessen the cost of power to present consumers, and would supply to the electrochemical industry the cheap power essential for its success. The suggestion should be of particular interest to the lighting industries, in which the

daily load-factor varies greatly. The success of the plan depends, of course, upon the rate at which this power could be supplied.

Mr. Sperry's first paper, which was presented at the Ithaca meeting of the American Electrochemical Society, gave figures for this which seemed low—so low, in fact, that they were questioned by others at the meeting; and at the recent meeting of the society a reply was made to Mr. Sperry by Mr. John Meyer, who took the position that the opinions held by Mr. Sperry were too optimistic. In the discussion which followed, the great importance of the problem to the electrochemical industries was admitted by all, although they did not agree as to the cost of this power when supplied as suggested by Mr. Sperry; and it was suggested that the matter be carefully looked into by the society in order to obtain more information upon it.

On the other hand, the electric lighting industry is looking for just such an outlet for its unsold power as is here suggested. It would seem that the problem is of nearly as great importance to it as to the electrochemical industry. At the present time the latter usually seeks a waterfall, even when the site is inconvenient, doing this simply because it can not afford to pay the usual rates, and does not see its way to entering into the power generating business itself. If the electric light companies could offer rates for power, taking into consideration the way in which it will be used, which would approach the rates now obtainable from the large hydroelectric companies, they would undoubtedly be able to fill up their load curves in a very desirable way. It must be remembered that the plan is not entirely simple. Certain complications would be sure to be encountered; but by proper adjustment these possibly might be overcome. The whole matter simply hinges upon the rate at which they can afford to sell this power, under suitable restrictions.

Bearing on this problem, in a way, was another paper read also before the American Electrochemical Society by Professor Charles E. Lucke. This is entitled "Power Costs," and gives the author's careful estimates of the cost of generating one kilowatt-year by water power, oil engines, gas engines and steam engines. These costs, of course, vary with the size of the equipment and the cost of development. The latter factor is important for water-powers, where the development costs vary so greatly. In this work the steam engine seems to be practically out of the race. The next in point of expense is found to be the oil engine, which can deliver one kilowatt-year for about $79. A gas engine using producer gas will reduce this figure to $65.50. A water-power plant brings it down, according to the development cost, to from $8.50 to $25. The latter figure is when the development costs $200 per kilowatt—the highest at present recorded. It is pointed out that it will pay to spend even more money than this on water powers where other considerations are not unfavorable. These figures, of course, show a considerable difference between the cost of power of a hydraulic plant and of plants operated in the other way. In the discussion of this paper, certain figures were given showing results even lower than those given by Professor Lucke, Mr. W. L. R. Emmett stating that a large turbine plant could generate power for about a quarter of a cent a kilowatt-hour. With such low costs for production it does not seem improbable that the needs of the electrochemical industries, or at least certain branches of them, might be supplied with profit to the power companies. The possibility is, at least, worth looking into on the part of the latter.

WATER POWERS AS RESOURCES.

The general public does not seem to realize the value of the water powers existing within any country. These are certainly to be considered as much a resource of the country as its coal mines or forests. They are capable of producing a commodity as salable as coal and wood, and certainly, if properly guarded, they are inexhaustible in the sense that they will continue forever; and this can not be said of the other two sources of power—the mine and the forest. The significance of this is that utilizing them does not consume anything that can not be replaced. On the other hand, the coal supplies will eventually be exhausted, the forests also will disappear unless they are properly protected, which merely means that the production of lumber will be reduced to a certain maximum.

After the art of transmitting electrical energy over considerable distances had been brought to a satisfactory condition commercially, water powers assumed a new value, at least in the eyes of those who understood what the new development signified. We have seen since then nearly every large water power in this country harnessed; we have seen companies formed for gathering in the water powers of certain districts and developing them for producing and selling electric power. Certain of these companies have acquired water powers whose aggregate power amounts to magnificent proportions, and we are now witnessing the development of certain rivers where large amounts of power are available, but where the engineering difficulties are great, and therefore the expense of the development will be large. Such work is, of course, only undertaken when the location of the power gives to it a special value. Another significant feature is the interest attached in the engineering world to the water powers in new and undeveloped countries. These, it is confidently believed, will become important factors in the development of those sections which are fortunate enough to be endowed with them.

But it is not only in the younger countries that the water powers are being utilized, for even in India and the other countries of Asia the waterfalls which have hitherto been unmolested are now employed for generating electric power, which, in turn, is used for doing the work formerly done by hand. This work of development is going on practically throughout the entire world. The engineer appreciates it; the developer and the man who buys the power realize its importance; but the layman shows little interest in the matter. He knows, in an indefinite way, that the water powers are being developed to generate electricity, yet he has no idea of the revolution in the industrial world which is thus being brought about. Naturally, therefore, he does not appreciate the true value of the water powers of his own state.

Preliminary Programme of the Thirtieth Convention of the National Electric Light Association.

New Willard Hotel, Washington, D. C., June 4, 5, 6 and 7.

THE following preliminary programme has been announced for the thirtieth annual convention of the National Electric Light Association, which will be held at the New Willard, Washington, D. C., June 4, 5, 6 and 7:

MONDAY EVENING—JUNE 3.

Opening of the exhibition of the Associate Members—eight o'clock.

Reception, followed by dancing—nine o'clock. The reception will be held in the meeting room, music being furnished by a section of the Marine Band. Both the exhibition hall and meeting room are on the tenth floor of the New Willard Hotel.

TUESDAY, JUNE 4—OPENING SESSION, 10 A. M.

Convention called to order by the president.

Introduction of General George H. Harries, vice-president, Washington Railway and Electric Company.

Address of welcome, Hon. H. B. McFarland.

President's address.

Announcements by the secretary.

Report of Committee on Progress, T. Commerford Martin.

"Accidents," Paul Lüpke.

"The Effect of Frosting Incandescent Lamps," Dr. Edward P. Hyde.

"Need for an Accurate Maximum Demand Meter for Measuring the True Energy of Polyphase Service." Discussion led by Louis A. Ferguson.

Question Box, Paul Lüpke.

Report of the Executive Committee, by the secretary.

EVENING SESSION—8:30 P. M.

Report of Committee on Electric Light Accounting, H. M. Edwards.

"Legal Justification for Differential Rates," Geo. Whitefield Betts, Jr.

"Recent Developments in Mercury Rectifiers," Frank Conrad.

"Report of Committee on Standard Rules for Electrical Construction and Operation," Ernest H. Davis.

"Report of Committee on the Fire Hazard of Electricity," C. E. Skinner.

"Report on Insurance and Kindred Matters," W. H. Blood, Jr.

Executive Session—Report of Committee on Membership Dues, W. H. Gardiner.

Report of Committee to Revise Constitution and By-Laws, Samuel Scovil.

WEDNESDAY, JUNE 5—10 A. M.

"New Developments in Arc Lamps and High Efficiency Electrodes," G. M. Little.

"Indefinite Candle-Power Ratings in Municipal Contracts," Henry Floy and E. L. Elliott.

Report of Committee to Consider Specifications for Street Lighting, Dudley Farrand.

Report of Committee on the Present Methods of Protection from Lightning and Other Static Disturbances, Alex Dow.

"Recent Developments in Protective Apparatus," D. B. Rushmore.

"Electric Heating Without Special Concessions from the Central Station," C. D. Wood.

"The Future of the Gas Engine," Lewis Nixon.

"Application of Gas Power to Central Station Work," J. R. Bibbins.

"Producer Gas Engines for Central Station Work" (illustrated by stereopticon), Robert T. Lozier.

"The Frequencies of Flicker at Which Variations in Illumination Vanish," A. E. Kennelly and S. E. Whiting.

"Efficiency of Various Methods of Illumination" (illustrated by stereopticon), E. A. Norman.

Report of Committee on Electric Heating and Cooking, James I. Ayer.

EVENING SESSION—8:30 P. M.

"Lightning and Lightning Protection," C. P. Steinmetz.

THURSDAY, JUNE 6—10 A. M.

Report of Freight Classification Committee, Ernest H. Davis.

"Recent Turbine Developments," W. L. R. Emmet.

"Power-Factor Correction," F. D. Newbury.

"Some Power Experiences," S. M. Sheridan.

"Municipal Ownership," Arthur H. Grant.

"Why We Failed in a Municipal Ownership Campaign," Glenn Marsdon.

"Italian Methods of Charging for Electric Current," Guido Semenza.

"Report of Membership Committee," J. Robert Crouse.

Report of Committee on Relations with Local Associations, S. R. Bradley, Jr.

Report of Committee on the Grounding of Alternating-Current Secondary Circuits, W. H. Blood, Jr.

EXECUTIVE SESSION—8:30 P. M.

Report of Committee on Relations Between Manufacturers and Central Stations, Henry L. Doherty.

Report of Committee on Rates and Costs, R. S. Hale.

Report of Public Policy Committee, Everett W. Burdett.

FRIDAY, JUNE 7—COMMERCIAL OR NEW BUSINESS DAY—10 A. M. AND 2 P. M.

"Scope and Character of Papers and Discussion," W. W. Freeman.

THE COMMERCIAL FIELD.

"Cooperative Commercialism in the Electric Field," J. Robert Crouse.

Report of National Electric Light Association Cooperating Committee, W. W. Freeman.

"Possibilities of Commercial Development," Henry L. Doherty.

"New Business—How to Get It—How to Keep It," F. M. Tait.

"New Business Results Demonstrated in Cities of All Sizes," J. E. Montague.

Discussion.

QUESTIONS OF POLICY.

"Sales Policy in Combination Gas and Electric Companies," F. A. Willard.

"The Electrical Jobbers and Dealers' Cooperation in Business-Getting," R. V. Scudder.

"Cooperation of the Electrical Trade Papers in Business-Getting," F. W. Loomis.

Discussion.

WIRING.

"How to Get the Old Buildings Wired," F. H. Golding.

"How to Get the New Buildings Wired," J. Sheldon Cartwright.

"Cooperation of the Electric Contractor in the Wiring of Buildings," James R. Strong.

Discussion.

THE SOLICITOR.

"Sizing Up the Territory—Preparing the Lists of Prospective Customers," George Williams.

"Qualifications of Solicitors for Different Classes of Business," F. W. Frueauff.

"How to Measure Results and Pay Solicitors," Leon H. Scherck.

"Increasing the Efficiency of the Sales Force," J. D. Kenyon.

"Value and Use of Solicitors' Handbook," R. S. Hale.

Discussion.

Adjournment for luncheon.

ADVERTISING.

"A Balanced Advertising Programme," Ralph Richardson.

"Advertising Results Demonstrated in Cities of All Sizes," E. S. Marlow.

"How to Make the Most of Newspaper Advertising," A. D. Mackie.

"Measuring the Results of Advertising," M. S. Seelman, Jr.

"Value of the Service of the Advertising Agency or Specialist," Lawrence Manning.

"Display Room and Demonstration as Business-Getters," E. R. Davenport.

"New Business by Indirect Methods," L. D. Mathes.

Discussion.

LIGHT.

"Illuminating Engineering as an Aid to Securing and Retaining Business," C. F. Oehlmann.

"Methods of Securing Residential Business," R. W. Hemphill.

"Cooperative Lighting of Streets by Merchants," H. J. Gille.

"Methods of Securing Sign, Window and Outline Lighting," Homer Honeywell.

Discussion.

POWER.

"Methods of Securing Power Business," Geo. N. Tidd.

"Catering to Power for Automobile Charging," R. W. Rollins.

"Establishing Day Circuits in Towns of 10,000 Population and Under," F. H. Plaice.

Discussion.

HEATING.

"Methods of Exploiting Electric Heating Devices," T. K. Jackson.

Discussion.

"Review of Advertising" (illustrated with stereopticon slides), C. W. Lee.

"Memorials," T. C. Martin.

Report of the Nominating Committee.

Election of officers for the ensuing year.

Adjournment.

PROGRAMME OF ENTERTAINMENTS.

On Tuesday morning there will be a two-hour automobile trip for the ladies.

On Tuesday afternoon a special reception will be given by President Roosevelt. In the afternoon there will be car rides to Cabin John, stopping for an hour at Glen Echo. In the evening there will be a theatre party at the Columbia theatre for the ladies.

On Wednesday morning there will be another automobile ride for the ladies. In the afternoon there will be an exhibition cavalry drill at Fort Meyer. The ladies are invited to attend the lecture by Dr. Steinmetz in the meeting hall at 8:30. There will be a ball in the small ballroom at the New Willard at 9:30.

Thursday morning there will be an automobile ride for the ladies. In the afternoon a visit will be made to Mount Vernon, going by boat. In the evening the ladies will visit the Congressional Library and other points of interest.

On Friday, in the morning, the ladies will make another automobile trip, and in the afternoon there will be visits to the National Museum and Corcoran Art Gallery.

The exhibition promises to be a great success. Nearly all of the seventy-eight booths have been taken. Many of the companies will have working exhibits. Arrangements have been made to decorate the exhibit hall, which will, of course, add to the attractiveness of the various booths. The following associate members will take part in the exhibition:

American Electric Heater Company, Allis-Chalmers Company, Harold P. Brown, American Instrument Company, W. J. Barr Electric Manufacturing Company, Crocker-Wheeler Company, Crouse-Hinds Company, Curtis Advertising Company, Dearborn Drug and Chemical Company, Dossert and Company, Electric Storage Battery Company, ELECTRICAL REVIEW, *Electrical World*, Federal Electric Company, Fibre Conduit Company, Fort Wayne Electric Works, Francis Raymond (Sheldon School), Franklin Electric Manufacturing Company, General Electric Company, John L. Gleason, Jandus Electric Company, H. W. Johns-Manville Company, C. W. Lee Company, Metropolitan Engineering Company, M. O. Publishing Bureau, National Electrical Supply Company, National Electric Lamp Association, New York Beck Lamp Company, Oneida Community, Limited, Pettingell-Andrews Company, Philadelphia Electric and Manufacturing Company, Pittsburg Transformer Company, Pope Motor Car Company, Simplex Electric Heating Company, Standard Paint Company, Standard Vitrified Conduit Company, Southern Exchange Company, Telelectric Music Company, Wagner Electric Manufacturing Company, Western Electric Company, Westinghouse Companies, Weston Electrical Instrument Company.

New York Electrical Society.

On Saturday afternoon, May 25, the 350 members of the New York Electrical Society visited the Port Morris power station of the New York Central & Hudson River Railroad Company, through the courtesy of W. J. Wilgus, vice-president of the company. G. H. Condict, president of the society, called a meeting of the members at one end of the spacious boiler room, and introduced Edwin B. Katte, chief engineer of electric traction of the New York Central. Mr. Katte very briefly recited some of the principal features of the plant, and welcomed the members of the society to an informal inspection. The members then dispersed, following guides, who explained the various features of construction and operation.

BOOK REVIEWS.

"'The Electrician' Wireman's, Lineman's and Mains Superintendent's Pocket Book." Second Edition. F. Charles Raphael. New York. The D. Van Nostrand Company. Leatherette. 392 pages. 3¼ by 8 inches. Diagrams. Supplied by the ELECTRICAL REVIEW at $2.

This book explains the English practice for house wiring, running underground and overhead conductors for light, power, telegraphy, telephony, railways, etc. It discusses in detail the apparatus and method of installing, testing, locating faults, the instruments employed, and gives the rules enforced, in Great Britain, by the insurance companies and the board of trade.

"Engineering Index Annual." New York. *The Engineering Magazine*. Cloth. 400 pages. 7 by 9½ inches. Supplied by the ELECTRICAL REVIEW at $2.

The Engineering Magazine has compiled the "Engineering Index Annual" for 1906. This follows closely the appearance of Vol. IV, and brings the index down one year closer to date. It contains all the entries which appeared in the monthly installments published in *The Engineering Magazine* down to the beginning of 1907. Instead of the usual strict alphabetical arrangement followed in the five-year volumes, the annual retains the classification used in the magazine for the benefit of the specialist who desires to see the current literature of his subject assembled in a definite, limited space. This classification is explained in the fore part of the volume. The volumes of the index which have been published to date have been of the most acceptable character, and a source of satisfaction to every one interested in engineering research. The high character of the work indicated in the preceding volumes is maintained in the present annual. The object of the publisher in bringing the index down to so late a date, thus affording every one requiring information upon the myriad subjects involved, is a worthy one, and will be appreciated in every quarter of the globe.

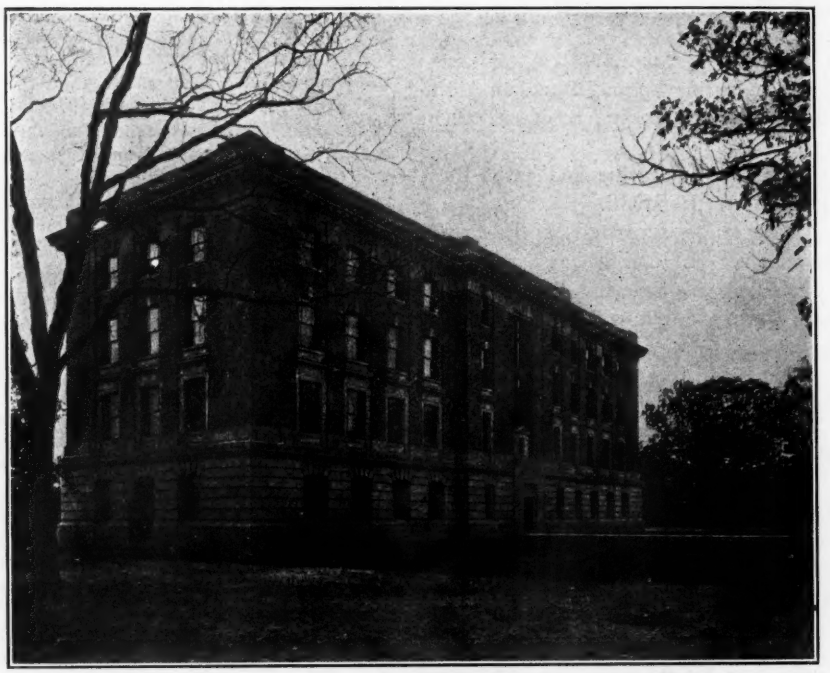
ELECTRICITY IN WASHINGTON, D. C., AND ITS ENVIRONS.

A BRIEF OUTLINE OF SOME OF THE MORE IMPORTANT INTERESTS WITH WHICH ELECTRICAL DEVELOPMENTS HAVE HAD TO DO IN THE CAPITAL CITY.

In probably no city in the country will there be found such a diversity of electrical applications as in the city of Washington, D. C. Not only has the development of the traction, lighting and telephone companies been carried forward to meet the most modern requirements, but there is a dignity and courtesy characterizing the employé of the public service corporation in the capital city that distinguishes him from employés in similar pursuits in any other city in the country. Then, again, Washington is historic electrically in several ways.

First and foremost, Washington is the home of the National Bureau of Standards, organized July 1, 1901, as one of the bureaus of the Treasury Department. On July 1, 1903, it was transferred, along with certain other bureaus, to the newly established Department of Commerce and Labor. The functions of the Bureau of Standards are briefly stated in the act of Congress by which it was established. The Bureau is to acquire, and construct when necessary, copies of the standards adopted or recognized by the Government, their multiples and subdivisions; to make accurate comparison of these with standards of instruments and standards employed in scientific investigations, engineering, manufacturing, commerce and education; to conduct researches pertaining to precision instruments, and to determine physical constants and properties of materials. The Bureau is also to furnish such information concerning standards, methods of measurement, physical constants and the properties of materials as may be at its disposal, and is authorized to exercise its functions for the Government of the United States, for state or municipal governments, for scientific societies, educational institutions, corporations, firms or individuals, and, as a matter of international courtesy, sometimes serves foreign governments. No fees are collected for service performed for the national or state governments; to others a reasonable fee is charged. To carry out these functions, Congress appropriated $25,000 for a site, $325,000 for buildings, and $225,000 for apparatus and equipment. The site lies in the northwest suburbs of Washington, just north of Cleveland Park.

All positions in the Bureau are filled by civil service examinations, and in some cases as the result of special examinations. The administration of the Bureau is apportioned in three divisions. Division 1 is under the charge of Professor S. W. Stratton; division 2, under the charge of Professor E. B. Rosa, and division 3 under the charge of Professor W. A. Noyes. Division 1 comprises six sections, as follows: weights and measures, heat and thermometry, light and optical instruments, engineering instruments, the office, and the instrument shop. Division 2 comprises six sections, as follows: resistance and electromotive force, magnetism and absolute measurement of current; inductance and capacity, electrical measuring instruments, photometry, engineering plant. Division 3 comprises the chemical work of the Bureau.

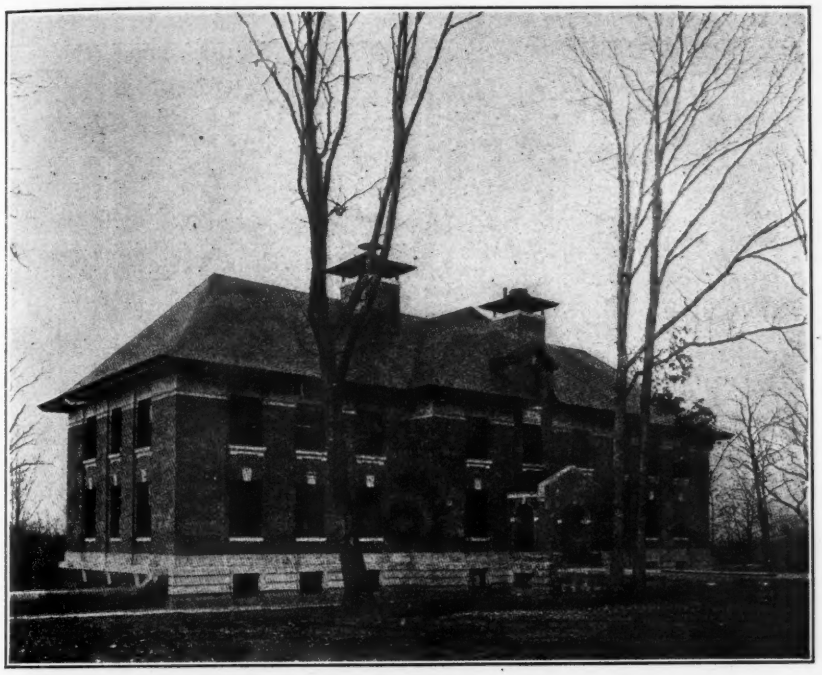


PHYSICAL BUILDING, FROM THE NORTHEAST—NATIONAL BUREAU OF STANDARDS.

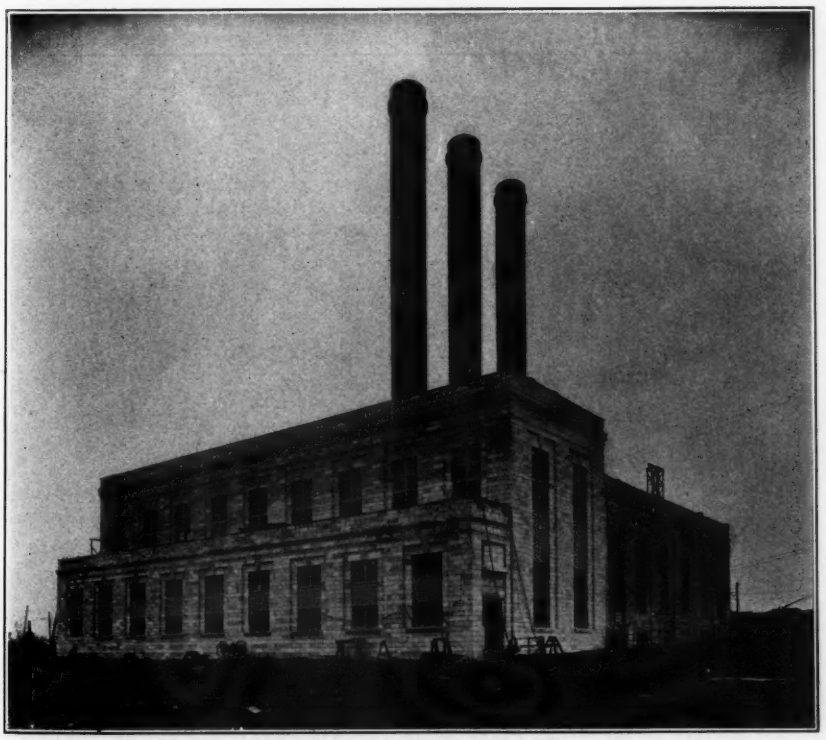
Turning now to the commercial element of electrical development in Washington, it may be pointed out that this was the first of American cities to possess a complete passenger-carrying conduit electric railroad. The first street railway company was established in Washington forty-five years ago. For a long time it was most unprofitable. After a quarter of a century of horse-car operation, with equipment changed but very little in any of its characteristics, two companies were formed —the Capital Traction and the Columbia Railway companies. Certain interests opposed to open trolley construction had successfully waged a war against this form of construction, and the result was legislation forbidding the overhead trolley and authorizing "any company authorized by law to run cars propelled by horses in the District of Columbia to substitute for horses electric power by storage or independent electric batteries or underground wire or underground cables moved by steam power." The two companies named above proceeded to install an expensive and generally troublesome cable, and for several years operated these systems with more or less success. When the Washington Traction and Electric Company, now the Washington Railway and Electric Company, appeared upon the scene in Washington, there were many street railway organizations, mostly disconnected, and generally antagonistic. The work of merging and combining the best of these systems required a large amount of capital and a wonderful expenditure of effort in rehabilitation and reorganization. At the present time the Washington Railway and Electric Company controls all the railroads heretofore operating in the city, being made up of the old Metropolitan, Columbia, Washington, Great Falls and Anacostia & Potomac River companies. Interurban systems running to Ellicott City and Baltimore are also being developed.

It was nearly twenty-five years ago that the first efforts were made to use electric current for lighting purposes in Washington. The Society of the Army of the Cumberland was holding a reunion at the national capital, and one of the features of the celebration was to be the illumina-

tion of Pennsylvania avenue, from the Peace Monument to the Treasury Building. A dynamo was secured and operated from an engine in a saw-mill on Thirteenth street. The experiment was anything but a success, but the disappointment centred in the minds of a few hardy investors the idea that if proper arrangements could be made, electric lighting would undoubtedly be very popular in the District of Columbia. In about a year the United States Electric Lighting Company was organized. In 1885 the lighting company's plant was destroyed by fire. Since that time, however, old equipment has been replaced, changes have occurred in the administration, and splendid modern buildings housing the most up-to-date plant have been erected. A few years ago the Potomac Electric Power Company absorbed the United States Electric Lighting Company, and the former company now supplies all the power needed for electric lighting purposes and nearly all the power used by the railroads controlled by the Washington Railway and Electric Company. The new steam turbine plant of the Potomac Electric Power Company is shown in one of the illustrations herewith. This was designed and constructed by J. G. White & Company, under the direct supervision of L. E. Sinclair, general superintendent of the power company. The plant is located near Bennings Road Bridge, on the eastern bank of the Anacostia river, just outside of Washington. The boiler room is 164 feet long and 180 feet wide, arranged to accommodate four rows of boilers, forming two firing aisles. The generating room is 164 feet long by forty-five feet wide, and has been laid out to accommodate three 5,000-kilowatt and two 2,000-kilowatt turbines. There is an annex fifteen feet wide by 164 feet long for switching compartments, offices, etc. The building is erected on piles and concrete footings, the entire area covered amounting to 29,520 square feet. The normal output of the plant is 19,000 kilowatts. Up to the basement floor, all wall and column footings are made of concrete, while the superstructure consists of a self-supporting steel skeleton frame. The walls are of hollow concrete blocks, self-supporting, with the exception of a few of the lighter walls.



MECHANICAL BUILDING, FROM THE SOUTHWEST—NATIONAL BUREAU OF STANDARDS



NEW STEAM TURBINE STATION OF THE POTOMAC ELECTRIC POWER COMPANY.

Of the side trips from the national capital suggested in connection with the forthcoming annual convention of the National Electric Light Association at Washington none will, perhaps, interest a greater number of delegates than that enabling a visit to the Great Falls of the Potomac river, the scene of a proposed power development, that if carried out as projected would rank as one of the most important plants of the kind on the Atlantic seaboard.

Great Falls is located about sixteen miles up the river from the city of Washington and was, until about a year ago, not readily accessible, save by a long carriage drive. Twelve months since, however, there was completed an electric suburban line known as the Great Falls and Old Dominion Railroad, which has a fourteen-mile double-track road extending from Georgetown, D. C.—or rather from

Rosslyn, Va., on the opposite bank of the Potomac—direct to Great Falls. This road in itself is likely to prove of interest, inasmuch as both steam and electric power are used. Ultimately, of course, electric power will be used exclusively, but pending the completion of the contemplated equipment there have been brought into requisition a number of the steam locomotives and cars formerly in use on the Manhattan Elevated Railroad in New York when that line employed steam power. This supplementary rolling stock is used on the Great Falls line only for hauling freight and to care for excess passenger business when the latter class of traffic is too heavy for the motors.

The descent made by the water at Great Falls is about eighty feet, and it is estimated that at least 40,000 horse-power can be developed here at a comparatively moderate price for installation. All the land for some distance on either side of the falls—on both the Virginia and Maryland sides, the river here forming the boundary between these states—as well as all the water-power rights, are controlled by the Washington Railway and Electric Company, the $13,000,000 corporation that controls eleven city and suburban roads in Washington, as well as the Potomac Electric Power Company. An unofficial estimate of the value of these power rights recently made was in the neighborhood of $2,000,000.

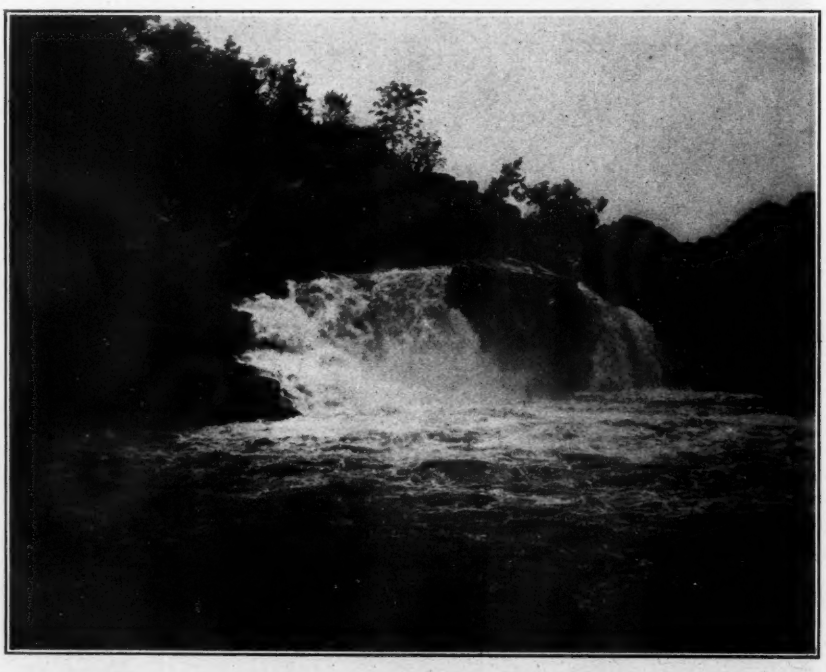
However, the project of the development of power from this source is for the time being in abeyance, by reason of the fact that the Potomac Power company has just completed the turbine station described above, which will, for the time being, furnish all the current needed in its field of operations. However, plans and estimates covering an installation at Great Falls have been prepared, and should there be a development of manufacturing industries in the vicinity of the city of Washington, as now seems probable, it is likely that advantage will be taken of the energy provided by nature.

One of the features of Washington as a city is the almost entire absence of wires, either for railway, lighting and power, or telephone and telegraph service.

Another important public service corporation in Washington is the Capital Traction Company. This company is a consolidation of the old Washington & Georgetown Railroad Company and the Rock Creek Railroad Company. The Capital Traction Company was organized in September, 1895. Its system comprises the Pennsylvania avenue, Fourteenth street, Seventh street and Chevy Chase lines, over fifteen miles of double-track conduit electric, and five miles of double-track overhead trolley line. The conduit construction is similar to that of the New York surface lines.

GREAT FALLS OF THE POTOMAC—SCENE OF PROPOSED POWER DEVELOPMENT.

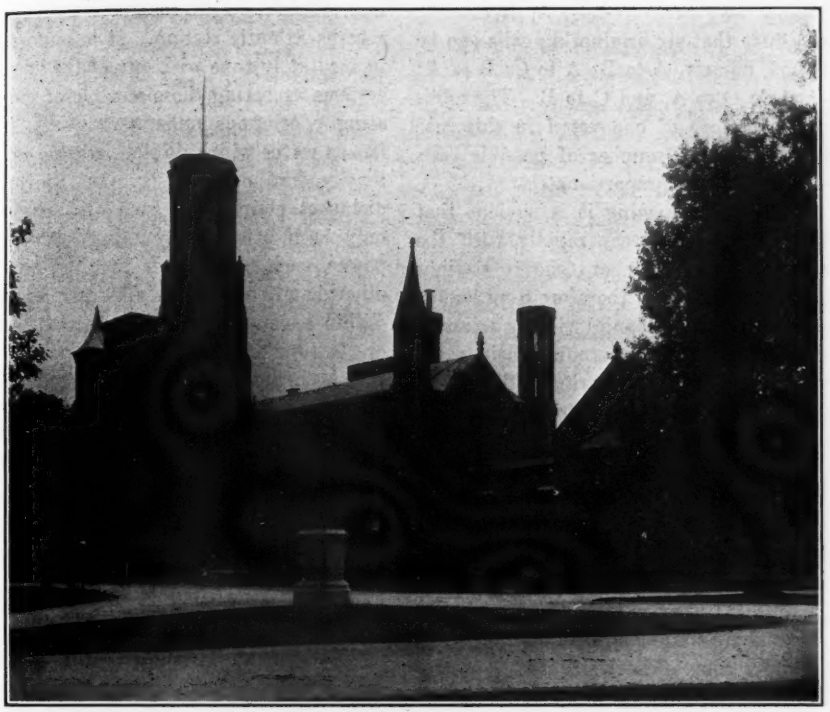
The telephone service in Washington is operated by the Chesapeake & Potomac Telephone Company, and the American Telephone and Telegraph Company has, of course, headquarters in the capital city. The Washington telephone service has been regarded as an ideal self-contained system. The service furnished to the Federal Government is of great importance, and has been developed in a most careful and painstaking way, so that the President may sit at his desk and get into instant communication with any member of his cabinet or with any department of the Government in the District or thousands of miles away.



A SECTION OF THE GREAT FALLS OF THE POTOMAC—SCENE OF PROPOSED POWER DEVELOPMENT.

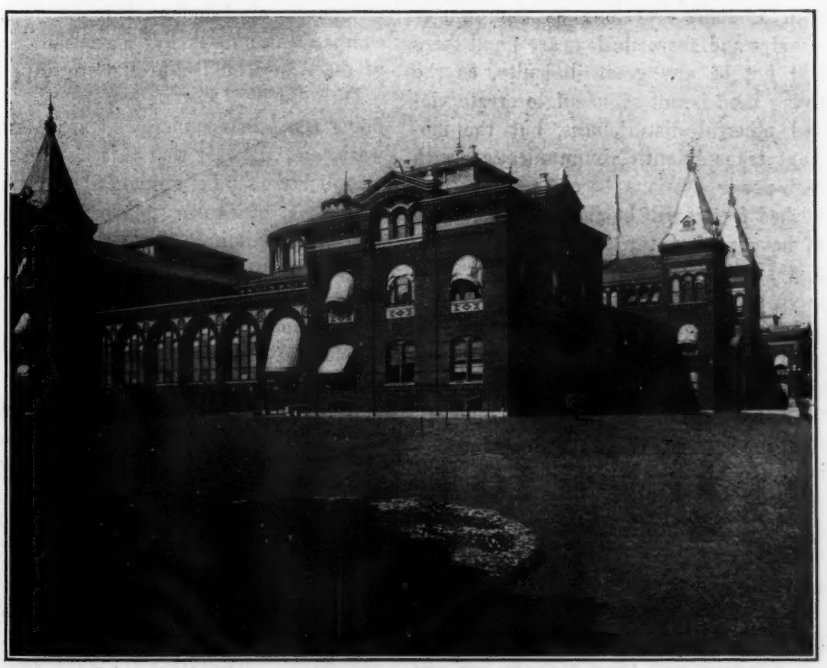
The Government Printing Office, on the

corner of North Capital and G streets, has one of the best-equipped self-contained electric plants in the country. The power-



The Smithsonian Institution.

house is 112 feet by 134 feet in plan, and is equipped with Crocker-Wheeler generators and a complete motor equipment for



The National Museum.

operating the various machines throughout the printing plant.

Of course, few persons of a scientific turn of mind fail to visit, while in Washington, the Smithsonian Institution and the National Museum. The Smithsonian Institution, which takes a prominent place among the learned institutions of the world, was founded by Congress in 1846, through the generosity of James Smithson, an Englishman, who, in 1829, bequeathed his entire property "to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." The original fund of about $515,000, with certain additions, has, by provision of law, been drawing annually six per cent from the United States Treasury. This fund has now increased, by accumulations of interest and by public contributions of individual donors, to over $900,000. The Smithsonian Institution has a library of 250,000 volumes, mostly deposited with the Library of Congress, and is the custodian of the national collections. The collections in the Smithsonian Building comprise birds, fishes, reptiles and invertebrates. The archæological collections are particularly rich in American antiquities.

The National Museum, which is under the direction of the Institution, is supported by an annual appropriation of Congress. The building adjoins that of the Smithsonian Institution. In 1901 there were 5,000,000 pieces classified in the collections. It is the recognized depository for all objects of scientific and artistic interest which come into the possession of the Government. Its special function is to preserve these treasures perpetually, and so to administrate them as to make them serve the most useful ends for those who desire to examine them.

The Land and Building Fund of the American Institute of Electrical Engineers.

The annual report of the American Institute of Electrical Engineers shows that the building fund committee had received, on April 30, a total of subscriptions of $163,734 from 934 subscribers. The amount actually collected and deposited is $124,829. There remains about $20,000 still to be raised. About seventy-five per cent of the members have not yet contributed. The building fund committee is sanguine of securing the entire amount to be raised, $185,000, during the current year.

Dangers to Life in Colleges.

An impressive presentation of the dangers to life from fire now existing in many of our colleges is made in the May issue of *Insurance Engineering*. This journal discusses several recent disastrous college fires, including the destruction of a fraternity house at Ithaca, a dormitory at Philips Exeter Academy, and two university buildings at McGill University, Montreal. There is given also a record of recent fires in college buildings and a summary of college fires for the past eighteen years.

THE COMMERCIAL FUTURE OF WIRELESS TELEGRAPHY.

BY E. MILLIAN TRINKS.

So much has been written about the scientific and practical features of wireless telegraphy that it may be interesting to consider at this time its ultimate commercial value.

The uses to which wireless telegraphy can advantageously be applied are manifold and may roughly be divided into three classes: (1) commercial, (2) life-saving, and (3) military.

The field for life-saving is limited to installations upon light-ships and light-houses, and for military purposes to low-power installations used in the army and navy. In a general way both these classes are of assistance to commercial wireless telegraphy and usually cooperate in forwarding messages.

The commercial field being by far the largest, should receive most consideration. This field may be subdivided into two classes, the first of which consists of manufacturing and selling outright apparatus built under the protection of patents, and the second in undertaking the work of an operating company.

It is evident that the outright sale of apparatus can bring only a limited profit on account of the very great competition; so fierce at times that government work must be undertaken at a loss—and if one considers that the different governments are large consumers of wireless telegraph apparatus, the price obtained is of great importance. Furthermore, there can be no future benefits whatsoever after the sale of apparatus is consummated, and the field must ultimately decrease.

Coming to the subject-matter of this article, namely, the work done and the future of operating companies, we find among the most prominent the Atlantic DeForest Wireless Company and the Marconi Wireless Telegraph Company. These companies equip ships and shore stations, and, operating them, derive an income in proportion to the actual work done. In course of time more and more sea-going vessels will be equipped with wireless telegraph apparatus and the revenue will increase quite out of proportion to the number of vessels operating. This can be best explained by comparing such stations with those of a telephone exchange in which the number of originating calls increases faster proportionately than the number of new subscribers; for instance, suppose two vessels, A and B, were equipped with wireless apparatus. It is evident that only two different originating calls can take place, from A to B or from B to A; the sources of income in this case, therefore, are limited to the number of vessels.

Now take three vessels, A, B and C; one finds that six originating calls can be traced, namely, A to B; A to C; B to A; B to C; C to A, and C to B. The addition therefore of one vessel in this case has trebled the number of possible calls and the income proportionately.

From the foregoing it is obvious that revenue increases very rapidly with the number of ships or shore stations equipped. It would therefore seem logical on the part of companies wishing to establish a permanent and sound business, to spend time and money in getting ships equipped and operating, as such a course of action must prove of future benefit.

Many of the big shipping companies are now well fitted with apparatus and are already doing a large daily business. In order that satisfactory communication may at all times be had between ships and shore it is necessary to have a large number of shore stations, the expense of which is large, comparatively, as few messages are sent from a land station, whereas a ship sends and receives about an equal number.

The qualifications of the different systems of wireless telegraphy used will be of very great importance in the future on account of the interference of one message with another. As long as the number of ships and shore stations are small there will not be any great difficulty, as the power used is not sufficient to create violent ethereal disturbances, but the moment trans-Atlantic communication with high-power stations becomes an accomplished fact it will be absolutely necessary to have perfect tuning; and this means that sending and receiving stations must be in syntony.

Interference of simultaneous messages is prevented by tuning the receiving circuit to a certain transmitter circuit, so that they are in sympathetic resonance; that is, each operates on the other to the exclusion of all other disturbances. The principle is exactly the same as when two musical strings are tuned alike; when one is struck the other vibrates sympathetically and with that note alone.

The present systems work satisfactorily over limited distances with relatively small power, and large stations can and have undoubtedly worked over distances equal to that between Europe, and, for instance, Canada, but such systems would be quite inadequate to maintain permanent communication because of the liability of other messages interfering; for instance, a ship equipped with low-power apparatus would, on nearing a shore station, interfere with the receiving end of a trans-Atlantic station. It is impossible to accurately tune with any of the present systems excepting those capable of generating continuous undamped waves, that means waves which do not decrease in intensity, and one can say that the great distances claimed by such systems have only been attained by using very high power, such high power tending, on the other hand, to disturb all other stations within a shorter radius, whether the same are in tune or not.

A system must therefore be devised which is capable of absolute and accurate tuning if wireless telegraphy is to be used in the future for commercial trans-Atlantic communication. That such communication will represent the largest and most reliable source of revenue for operating companies can not be doubted.

At the present day there are several methods which have been shown capable of such tuning, but of such methods only that of the Danish inventor Vladimar Poulsen, of Copenhagen, has been commercially developed. The rights to this system, which entails very inexpensive apparatus and uses very low power to cover long distances, have been acquired by the Amalgamated Radio Telegraph Company, of London, England, which company also owns the European rights of the American DeForest Company.

Only such a system can be used for doing constant commercial trans-Atlantic work, and the fact that this has been accomplished may be announced very shortly. It is, of course, unnecessary to say that such communication will be a serious menace to the income of the different cable companies on account of the low cost of installation and maintenance of wireless equipment and the reduced rates made possible thereby.

When such stations have been installed in sufficient numbers with vessels equipped in the same way it will be possible to get into communication with any point in the world, and in order to have the system as flexible as possible the apparatus on board vessels and land stations will be arranged in such manner that they can alter their wave-lengths at will. This will enable one station to select another with which it wishes to communicate without the slightest chance of outside interference.

These assertions can be proven and the

writer has personally examined several stations already equipped with apparatus built according to the Poulsen system. The possibility of tuning in such stations is as nearly perfect as it is possible to determine with present measuring instruments, and it is quite simple to receive several different telegraphic messages on one and the same antennæ, or to send and receive at the same time.

This would indicate that multiplex wireless telegraphy, with the Poulsen system, is an assured fact, and this will tend to lessen the cost of trans-Atlantic communication, conveying a great boon to all business in general.

LETTERS TO THE EDITOR.

Electrical Driving for Fire Engines.

To the Editor of the Electrical Review:

Referring to the article on electrical driving for fire engines, page 787, issue of May 18, this describes a patent taken out in 1882, manufactured by the Silsby Fire Engine Company, fully tried at Schenectady and finally burned up at Ampere, in the fire of April, 1895. The patent expired about five years ago, but it fully described and illustrated the electric fire engine and a network of hydrants and the electric supply connections.

S. S. Wheeler.

Ampere, N. J., May 22.

Submarine Signaling.

To the Editor of the Electrical Review:

My attention has just been called to the article in your issue of March 30, 1907, entitled "Submarine Signaling," in which Professor Lucien I. Blake is given credit for being the progenitor of the system now in commercial service. The basis of the claim seems to be a paper read by him before the American Association for the Advancement of Science, in 1887, from which liberal quotations are made. Unfortunately for this claim there was nothing in Professor Blake's paper that had not already been published prior to 1887.

It has been a matter of common knowledge for centuries that sound will travel through the water and pass through the sides of a ship so as to be heard by an observer within the vessel. The experiments made by Colladon and Sturm in 1826 were not the earliest recorded, as stated by your contributor, for in 1767 a similar recorded test was made near the University of Glasgow in Scotland. Benjamin Franklin made some interesting experiments also. The natives of Ceylon in their fishing boats communicated with each other by sound signals made under water a very long time ago.

Shortly after the invention of the telephone and nine years before Professor Blake read his paper, an English patent was issued to Henry Edmunds, dated February 12, 1878, in which is shown submerged bells for producing sound signals, and submerged telephone transmitters for receiving them. In fact, every general suggestion made by Professor Blake is anticipated in this patent.

During the year 1887 (at the very time Professor Blake was discussing the theory of the matter), two patents were issued in the United States which proposed to make a practical application of the principles involved—which, by the way, Professor Blake did not attempt to do until two years later. One of these patents was issued to William G. Spiegel in July, 1887, and the other to John M. Batchelder in August, 1887.

On October 27, 1888, an English patent was issued to Neale and Smalpage, for attaching either a microphone or a pneumatic device on the principle of a speaking tube to the inside skin of a ship, by means of which it was hoped to receive the sound from the sea. This apparatus approaches that now in use, but it differs in one vital particular, which makes the difference between success and failure.

Up to this time Professor Blake's interest in the subject seems to have been wholly theoretical, but two years later he concluded to apply for a patent. His original application discloses his complete ignorance of what his predecessors had done, for he made very broad claims that covered their inventions. These claims were, of course, rejected by the Patent Office and he was obliged to drop them, leaving nothing of his original application except the use of a water siren for a sound producer, and a tuned resonating chamber for the receiving apparatus. The former has never been used, because it would certainly be inferior to a bell, and the latter is not adapted to receive bell signals. This is Professor Blake's only patent, issued to date, on the subject of submarine signaling.

Arthur J. Mundy.

Newtonville, Mass., May 16.

Receiver for the New York Tunnel Company.

The New York Tunnel Company, which has the contract for building the tunnel under the East river, from the Battery, New York city, to the borough of Brooklyn, has been declared an involuntary bankrupt by Judge Holt in the United States District Court. T. T. Wells was appointed receiver on Friday, May 23, under bonds of $25,000, with instructions to continue the business for twenty days.

COPPER PRODUCTION IN 1906 AND THE PRESENT OUTLOOK.

BY JOHN B. C. KERSHAW.

The demand for copper during 1906 has been in excess of the supply, and as a result the price has advanced to a figure never before attained in the history of the metal.

When it is remembered that within eleven years the price of copper has advanced from £42 17*s.* 6*d.* to over £110 per ton, although the output has been doubled, the seriousness of the position will be recognized. At the present time the world's consumption of copper appears to be at the rate of 700,000 tons per annum. It is evident that the mines now being worked can not long continue to meet this enormous drain upon their resources, and that unless new stores of copper ore are tapped, or unless some substitute for copper be found, a veritable famine in the red metal is likely to result.

In what follows, the production figures for the last seven years are submitted to a careful and detailed examination, with a view to discovering whether the mines now being worked show any great power of increasing their output in accordance with the increased demand. The price variations of recent years are also recorded, and the difference between the present reign of high values and that of previous years is pointed out. The writer's reasons for thinking that a return to a more normal level of price is likely, are finally given.

PRODUCTION FIGURES FOR 1906.

The aggregate production of copper by all countries of the world in 1906, according to the valuable statistical return compiled and published by Messrs. H. R. Merton & Company, has been 711,675 tons.

This represents an increase of 29,500 tons upon the total for 1905. Though this increase is noteworthy, it is smaller than that which characterized the returns for the preceding years, the aggregate output and percentage increase for the seven years—1900-1906—having been as follows:

Year.	Aggregate Output by all Countries. Tons.	Increase. Tons.	Percentage Increase.
1900	479,514		
1901	516,628	37,114	7.7
1902	541,295	24,567	4.7
1903	574,775	33,480	6.1
1904	644,000	69,225	12.0
1905	682,125	38,125	5.9
1906	711,675	29,550	4.3

The increase of 1906, expressed as a percentage, is thus seen to have been the smallest since the year 1900. The figures,

in fact, indicate that the producing capacity of the present mines has attained nearly its maximum limit, and that any marked increase in the world's supply of copper can only come from the opening up of new mines in hitherto undeveloped districts.

Turning now to the output of raw copper by the various countries, and taking our figures from Messrs. H. R. Merton & Company's circular, we have the following figures for the six most important contributing countries:

Country.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
United States.....	263,502	265,250	292,870	307,570	365,050	389,120	408,475
Mexico	22,050	30,430	35,785	45,315	50,945	64,440	60,625
Spain and Portugal.	52,872	53,621	49,790	49,740	47,035	44,810	49,320
Japan	27,840	27,475	29,775	31,360	34,850	35,910	42,740
Australasia	23,020	30,875	28,640	29,000	34,160	33,940	36,250
Chili	25,700	30,780	28,930	30,930	30,110	29,165	25,745

The most striking feature of these figures is the increase in the production of the United States mines from 263,500 tons in 1900 to 408,475 tons in 1906. These mines are in fact now producing more copper than all the countries of the world produced in 1897, and the percentage increase in the period 1900-1906 has been no less than fifty-five per cent.

The increase has occurred chiefly in the output of the mines located in Arizona—this output was 49,447 tons in 1900 and had risen to 118,435 tons in 1906. The mines of Montana have produced 130,000 tons in 1906, as compared with 114,144 tons in 1900, while the Lake mines have contributed 99,900 tons, as against 69,300 tons in 1900.

The other noticeable points brought out by the tabular statement are the rise of Mexico and of Japan among the copper-producing countries of the world and the decline of Spain and Portugal and of Chili.

In the case of Mexico, which now ranks second in the list of producing countries, the increase in the output has occurred chiefly in connection with outside mines. These mines in many cases had been previously worked, and the more easily extracted higher grade ore had been mined and smelted. The reign of high prices, however, has made it profitable to reopen these mines and to extract and smelt the ores of lower grade.

While the output of the famous Boleo mine in Mexico remains stationary at 11,000 tons, the output of these outside and at one time discarded mines has increased from 11,000 tons in 1900 to 49,795 tons in 1906. The maximum of their producing capacity, however, seems to have been passed, for the output of 1906 shows a falling off of 4,500 tons as compared with 1905.

Comparing now the output of the second group of producing countries—for the same period, 1900-1906—we have the following figures:

Country.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Canada	8,500	18,800	17,485	19,320	19,185	20,535	25,460
Germany	20,410	21,720	21,605	21,205	21,045	22,160	20,340
Russia	6,740	8,000	8,675	10,320	10,700	8,700	10,490
Peru	8,220	9,520	7,580	7,800	6,755	8,625	8,505
Cape of Good Hope..	6,720	6,400	4,450	5,230	7,775	7,325	6,540
Norway	3,935	3,375	4,565	5,915	5,415	6,305	6,120

Canada is the only country in this list the production of which has increased considerably since 1900. The promise of great development which was indicated by the jump from 8,500 tons in 1900 to 18,800 tons in 1901, however, has not been realized in the returns since that year. The remaining countries are obviously of little importance in connection with the copper supply of the future, for the production in the period 1900-1906 shows little expansion, and it would seem unlikely that any great increase of output can be expected from the copper mines now being operated in this group of countries.

PRICE VARIATIONS.

The average price of G. M. Bs. during 1906, according to Merton's circular, has been £86 5*s.* 2*d.*, this being the average of the prices on the first of each month.

The figures for the six preceding years have been as follows:

1900.	1901.	1902.	1903.	1904.	1905.
£73.10.7	£67.19.3	£52.13.5	£57.18.8	£58.14.8	£69.2.6

There have been three periods during the last twenty-five years during which the price of copper has risen above £70 per ton. In the year 1888 M. Secretan organized the Paris corner in copper, and for that year the average price of G. M. Bs. was £76 per ton. The Amalgamated Copper Company was formed in 1899. The average price of G. M. Bs. was then forced up to £72 16*s.* 6*d.* in 1899 and to £73 10*s.* 7*d.* in 1900, but the price had dropped again to its normal level of £52 per ton in 1902.

The year 1906 is the first of a new period of high prices, and consumers of copper are naturally anxious to know whether this period will be transitory like its predecessors, or whether the year 1906 marks a permanent increase in the price of the metal.

In attempting to answer this question it may be noted that the two earlier periods of high prices were due to financial manipulation of the market, and not to any unusual increase in the demand for the metal. So far as one can judge from the production figures, the present reign of high prices is due to natural causes—the demand for the metal has exceeded the supplies. This extraordinary demand for copper is due chiefly to the exceptional activity which has been observed in the trade of all countries during the last two years. Copper is a metal which enters into a very large number of manufactures, and active trade always increases the demand for it. As pointed out in *The Times*[1] (Financial Supplement) last year, the engineering and shipbuilding industries consume a very large proportion of the copper produced, and these industries have been enjoying lately a period of unexampled prosperity. The growth of the motor-car and motor-bus industries also have added to the general demand for copper, while the extension of electric tramways and the equipment of the London tube and other lines with electricity as motive power has undoubtedly increased the demand for the metal for electrical and conducting purposes.

Trade is, however, subject to periods of boom and depression, and with the slackening activity in the trade of the world, of which signs are now visible, there is likely to be a lessened demand for copper, and a check to the upward tendency of prices. This check in the demand is likely to be intensified by the very high level to which prices have been forced since September, 1906. In that month G. M. Bs. were selling at £86 17*s.* 6*d.* per ton, while on December 15 the price was £105 15*s.*, and on March 31, 1907, the price was £97 10*s.* It is natural with such a level of prices that consumers should restrict the use of copper to the lowest possible limit, and that they should be seeking in all directions for substitutes for the red metal.

It is probable, therefore, that the price of copper will gradually return to a more normal figure as trade slackens, though possibly the £52 per ton level, which was last seen in 1902, may not be again at-

[1] March 5, 1906.

tained. The hope for the consumer in the future lies in the discovery of new mining districts, and also in the discovery of reliable substitutes for the red metal in the arts and industries. As regards the former, Rhodesia and the district north of the Zambesi and the unexplored steppes of Eastern Siberia may be found to possess stores of copper and other metals, which the extension of the railways will render available for European and American users, while as regards substitutes for copper, the more durable alloys of aluminum may prove suitable for much of the work for which copper and brass are now employed. Aluminum may, in fact, become of great importance in the world's industries—for the oxide is one of the commonest constituents of the earth's crust and forms no less than seventeen per cent of the weight of the same. An aluminum alloy—red in color, which combined lightness and strength—would easily displace copper from its position as the ornamental metal in the arts and industries. Metallurgists would therefore be wise to turn attention to the production of such an alloy.

The Convention of the Southwestern Electrical and Gas Association.

The third annual convention of the Southwestern Electrical and Gas Association was held at San Antonio, Tex., May 14, 15 and 16. The convention headquarters were at the Menger Hotel. The address of welcome was delivered by Reagan Houston, former counsel and manager of the San Antonio Gas and Electric Company. This was replied to by H. S. Cooper, president of the association.

The first paper, entitled "Education of Legislators with Reference to Public Service Corporations," was read by H. M. Moore. Mr. Moore feels constrained to believe that most of the representatives elected desire to deal fairly with all interests. The only question with them is what is fair and equitable, or as nearly so as they can make it, considering the great variety of the interests involved. Public utilities corporations, in order to have any influence in the education of legislators, must be absolutely fair and honest in all their dealings with the legislators. They must not be approached with juggled figures and false statements, if success is to be achieved in convincing the legislators that the public utilities companies are right, and the legislators are wrong. There must be figures to prove it, and these figures must be truthful.

Other papers were entitled, "Labor-Saving Tools and Devices for Central Stations and Car Barns," by V. W. Berry; "The Value of Scientific Tests to Public Corporations,' by Arthur C. Scott, professor of electrical engineering, University of Texas; "Application of Gas to Mechanical and Industrial Uses," by D. N. Waplick, and "The Getting Up and Trying Out of Forms," by F. C. Randall.

The question box, edited by Samuel Kahn, is one of the most valuable which has been presented to any state association. These questions are intimately connected with the problems involved in public service corporation operation, and formed a very interesting and instructive part of the proceedings.

The evening of Wednesday, May 15, was devoted to a rejuvenation of the Sons of Jove.

The morning of Thursday, May 16, was devoted to the supply men. This proved to be one of the most interesting and useful sessions of the convention.

In point of attendance, work accomplished and exhibits shown, the convention was entirely satisfactory.

The following officers were elected: president, H. T. Edgar, vice-president and manager, Northern Texas Traction Company, Fort Worth, Tex.; first vice-president, W. B. Tuttle, manager, San Antonio Traction Company, San Antonio, Tex.; second vice-president, J. P. Crevar, president and general manager, Denison-Sherman Interurban, Denison, Tex.; third vice-president, J. F. Strickland, president, Dallas Securities Company, Dallas, Tex.; secretary, R. B. Stichter, Dallas Securities Company; treasurer, A. E. Judge, president and general manager, Tyler Electric Light and Power Company, Tyler, Tex.

A party of ladies attending the convention made a very enjoyable trip to the ruins of the missions associated with the early progress of Christianity upon the American continent, and forming part of the old Spanish settlement of San Antonio, as guests of Alexander Henderson, of the American Circular Loom Company, Chelsea, Mass., and C. W. Hobson, of the Hobson Electric Company, Dallas, Tex. The trip to the San Jose, La Conception and San Pedro missions was made in automobiles. On returning, the ladies were entertained at the reception rooms which had been fitted up for the convention by Mr. Henderson.

Civil-Service Examination for Chief Engineer.

The United States Civil-Service Commission announces an examination on June 26, in the usual cities where these examinations are held, to secure eligibles from which to make certification to fill a vacancy in the position of chief engineer in the United States post-office and court house building at Chicago, Ill.; and vacancies as they may occur in the custodian service throughout the United States requiring similar qualifications. The salary of the specific position to be filled will be from $1,800 to $2,500 per annum, the entrance salary to be at $1,800. Applicants should apply at once to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners in any of the cities where examinations are held, for application form 1,052.

The Sons of Jove Operetta.

The operetta given by the Chicago Jovian Club at the Association Auditorium, Chicago, Ill., on the evening of Thursday, May 16, entitled "The Isle of Jove," was a great success. The operetta was written and arranged for the Chicago Jovian Club by Frank L. Perry. The cast of characters included W. P. Crockett, Perry Boole, S. A. Rall, George H. Erich, W. S. Taussig, C. A. S. Howlett, Fred Skeel, Charles Gregory, W. R. Pinckard, A. O. Einstein, E. W. Kerns, C. N. Thorpe, Morgan Ellis, Francis Raymond, George Searing, Thomas Bibber, Warren Ripple and S. M. McFedries.

After the performance a banquet was held, when an elaborate menu was enjoyed.

The Illuminating Engineering Society.

A regular meeting of the New York section of the Illuminating Engineering Society will be held at 8.15 P. M., at the Edison Auditorium, 44 West Twenty-seventh street, New York city, Friday, June 14. A paper entitled "Industrial Plant Illumination," by George C. Keech, will be presented. This paper will deal with illumination by mercury vapor lamps, metallized-filament incandescent lamps and enclosed arc lamps.

In 1905 there were 784 establishments engaged primarily in electrical manufacture, with a capital of $174,066,026.

KEYBOARD PAGE-PRINTING TELEGRAPHS.

BY ROMYN HITCHCOCK.

No argument is necessary to prove that a reliable telegraph transmitter with a standard typewriter keyboard, which can be operated at typewriter speed, and a page-printing receiver, is more efficient than the Morse key and sounder, besides being an ideal apparatus. A considerable part of telegraph business is most advantageously done by hand; but there is no more reason to restrict hand working to the sending of dots and dashes than there would be to require letters to be written with a pen instead of typewriter. A keyboard page-printer bears much the same relation to the Morse key as the typewriter does to the pen. It is not possible to believe that telegraph business will always be done by ticking off dots and dashes, or that receiving will depend upon the presence of an operator to interpret and transcribe the signals.

The question of reliability is always raised by adherents of key and sounder concerning innovations. But all doubt as to this feature of printing telegraphs is set at rest by the long commercial use of such apparatus abroad, and to some extent in this country.

The accuracy of the comparatively slow operating devices known as stock and news tickers is well known, but even these work up to and above ordinary Morse speed. When we consider the automatic page-printers, such as the Buckingham and Barclay, which operate much more rapidly than hand sending, all question of the reliability or practicability of this class of apparatus is definitely answered.

While it is not the purpose of this article to deal particularly with telegraphic printers operated with punched tape transmission, it seems desirable to indicate their relation to keyboard machines. They are still in the early stage of development, and improvements are to be expected; but it is of interest to inquire what speed has been practically attained with automatic telegraphic printers.

It is difficult for an outsider to get satisfactory data upon which to base a conclusion as to the actual speeds of operating either the Buckingham or the Barclay printers. The present writer has become very sceptical concerning estimated or reputed telegraph speeds; but whether or not the speed of either of the printers mentioned is eighty or 100 words a minute, they both show a manifest improvement over Morse working; and this is important, not only because of the increase in operating efficiency, but also in practically asserting the superiority of machine transmission over the Morse key within its own special preserves. The Barclay machine appears to be the simpler in construction, and it is the one now favored by the authorities; but from various considerations it would seem that the Buckingham ought to possess some superiority in speed, or at least more reliability at the highest speed than the Barclay.

As for the actual increase in speed, whatever it may be, while it is faster than the Morse, it is not, presumbably, so fast as that of Wheatstone operation under the same conditions. So far as can be learned, or inferred, the Barclay machine is now doing less speedy work over the wire than has been available for fifteen years with the Wheatstone apparatus, the benefits of which have been mostly appreciated abroad. The advantage that can be claimed by the Barclay machine over the Wheatstone is that messages are received in printed form. This is a most important advantage, however, and may well offset some reduction in speed from Wheatstone practice.

The most important improvements in printing telegraphs have originated in this country, although the use of such apparatus has not been much encouraged on this side of the water. The Hughes-Phelps printer, still largely used abroad, has been wholly discarded here. We have several forms of stock and news tickers as the sole representatives of American genius in this field. The reliable old Hughes, with its piano-like keyboard, is steadily at work abroad, not exceeding a speed of forty words a minute with specially trained operators to work the keys. It is said that more work can be done on a duplexed line with the Hughes than by eight operators with quadruplex Morse. In France and Italy the Baudot printer is largely used. This multiplex system depends upon synchronism, and six messages can be sent simultaneously over one wire. The transmitter has five keys, and five impulses are sent for each letter, not regularly alternating in polarity, making thirty-two combinations. By a recent improvement a sixth impulse may be sent, almost simultaneously with the fifth, to effect word spacing, thus increasing the speed. The printing is on tape, and the speed claimed is three letters a second.

These printers are referred to because they demonstrate the practicability and advantage of printing telegraphs as commercially determined, tangible facts. But they are inferior in several respects to later inventions, and do not fulfill the requirements of apparatus for universal application. Not only are they too slow, but they require operators to be specially trained to use the keyboards. To be of general application in telegraph business, a machine must print in page form, like a typewriter, and the keyboard must be of the standard form, with free keys, capable of use at typewriter speed. A number of keyboard page-printing telegraphs have been devised, but in most of them the speed limitations have been so low that free-operating keyboards would be fatal to correct transmission. Serious difficulties have been encountered in attempts to make a typewriter keyboard that would serve as a transmitter at typewriter speed. The quotations of the New York Stock Exchange are still sent out from a circular keyboard which can only be operated by a few persons who are in constant training for the purpose. It is accurate in its work, but slow.

The production of an effective page-printer has not been a simple undertaking. Naturally the idea suggests itself that an ordinary typewriter could be operated by some local electrical receiving device which would select the keys. A number of inventors have proposed to operate in this way; but there is considerable difference between an electrical typewriter and a telegraphic printing machine. Mr. Barclay would seem to have been quite successful, however, in utilizing a certain form of electrical typewriter telegraphically; but it can not be admitted until further evidence is at hand that such apparatus is best for the purpose. It may be practicable, but only in telegraph offices where the apparatus can be under proper supervision, and one would naturally suppose that the separate selecting device for the keys might better be an integral part of a specially constructed printing mechanism. A typewriter is designed to operate with an easy finger touch, while an electrically worked printer should be a machine with more exact adjustments and smaller moving parts. The power necessary to operate a commercial typewriter is considerably more than would be required to do the printing with a specially constructed machine, and practicable speed decreases as the local power requirements at the receiving station increase.

For present purposes it is only necessary to refer to two forms of typewriter keyboard printers, since these are the only ones actually before the telegraph world in a fully developed condition. First is the remarkable multiplex printing telegraph invented by the late Professor Rowland, of Johns Hopkins University. As

a development of synchronous operation in long-distance telegraphy, this apparatus stands, theoretically, in advance of any others. This may be said without disparagement of the earlier invention of Delany, on a different principle, which is justly regarded as one of the great achievements in electro-mechanics. The Rowland apparatus may be worked in octoplex, eight keyboard operators sending over one wire at the same time, while eight machines automatically print the message in page form.

Whether the theoretical excellencies of the Rowland principle can be realized in practice remains to be clearly shown. The machines have been working for some time on the Rome-Naples line, and have apparently given the highest satisfaction. The Postal Telegraph Company has also made an installation of Rowland apparatus. But it would seem that multiplexing introduces certain limitations in operating speed, and while it is possible to use the Rowland system in octoplex or sextuplex, the full benefit of this means of utilizing conductors can only be realized in practice when it can be accomplished without reducing the speed of typewriter working. Rapid keyboard manipulation can not be maintained if there are mechanical restrictions upon the free and independent action of the keys. The Rowland machine has such restriction in the form of a locking device, hence there is a presumption that the speed can not equal that of ordinary typewriter practice, even when the operators become expert with the keyboard.

However, the Rowland apparatus is the outcome of years of competently directed experimental work, and even with this restriction in the speed of individual operators, it ought to be thoroughly practical and efficient, and capable of large extension in the regular telegraph service. That it can have other use, outside of the telegraph companies, is unlikely, since it is expensive to install and requires technical supervision.

The other page-printer referred to is known as the telegraphic typewriter, invented by J. E. Wright. This apparatus is of more general application than the elaborate Rowland machine. It is not costly, and can be utilized under all conditions, not requiring the facilities of a telegraph office. It can be operated on long lines, simplex or duplex, thus being adapted to general telegraph service, or it may be used locally, with a number of printers on a single wire operated simultaneously from one keyboard, thus affording an ideal means of news distribution for newspaper offices, etc.

One can not predict when the advantages of keyboard page-printers will be utilized in the general telegraph service of this country. Commercial experience with inferior telegraph-printers abroad leaves no possibility of doubt that the companies here would greatly benefit by the use of such apparatus. In making comparisons in Italy to determine the advantages of the Rowland apparatus, the standard was not Morse working, which a writer has named as the "yard stick" of carrying capacity in this country, but the more efficient Baudot printer, with results stated as follows: "The chief benefits of the new telegraphy lie in its sweeping reduction in the cost of transmission and its virtual multiplication of the existing telegraph wires. The octoplex installation on the Rome-Naples line requires but six-elevenths as many operators to transmit and receive a given number of messages, and multiplies the message capacity of the wire three times."

Perhaps the time is still in the distant future, but the keyboard printer must inevitably make its way into the national telegraph service. It will take less time to bring it into common use by press associations, and for private telegraph lines. The extent to which this innovation in correspondence, held back until now by the imperfections and limitations of available apparatus, will supplement the telephone, can not be foretold.

We have seen that page-printing telegraphs naturally fall into three classes; first the automatic or tape-transmission printers, such as the Buckingham; second, the multiplex keyboard printers like the Rowland, and third, the direct free-keyboard printer of Wright, which is virtually alone in the field. The first two are necessarily confined to general telegraph use, while the latter occupies different fields of its own, as already indicated.

In telegraph business an important question arises as to the relative advantages of tape transmission and direct keyboard multiplex working. It is obviously a question of operative efficiency determined by the volume of business that can be done. The speed of keyboard transmission has limitations which are known; but what is to be expected of the automatic? Is there reason to anticipate any notable increase of speed in the automatic printer over what has already been achieved?

One can not conceive a practicable telegraph receiver, dependent upon magnets to effect mechanical movements, more delicate than the Wheatstone. When movements of a printing mechanism are initiated with armature contacts of excessive delicacy, they are likely to prove uncertain. We may, therefore, reasonably assume that the limit of telegraphic speed for a receiving mechanism is that of the Wheatstone receiver. As each mark of the Wheatstone receiver is made more directly than is possible with any type-selecting and printing device, it is assumed that with the same number of impulses per letter and with magnets having the same time constants, the speed of printing can not exceed practicable Wheatstone speed. Printing telegraphs usually require as many or more impulses per letter than Wheatstone or Morse—mostly five or six—although there may be no time lost on prolonged signals corresponding to dashes. In this respect the Wright machine would seem to present possibilities in the way of automatic operation, for while the longest (and least used) character on that machine requires eight impulses, the average per letter is only three and a half, and in automatic working the average time per letter is the true measure of the speed.

Reference to the Wheatstone as a standard of comparison seems justified by the high degree of perfection attained in the construction of the apparatus during the many years of its commercial use. While remarkable claims of speed have been made for it, we are now considering only safe commercial speed over long wires, duplexed, which yields clearly legible records. This limit would seem to be approximately 100 words a minute, and the writer is of the opinion that no material increase in telegraph speed over the Wheatstone is to be attained except by the elimination of mechanism in the receiving apparatus by the adoption of electrolytic recording.

The conclusion seems natural enough, in view of the indisputable facts before us, that page-printing telegraphs can not be excluded from the telegraph service. The business will be done almost wholly by such apparatus, using the simpler keyboard apparatus for local and short or branch lines; either the automatic or the multiplex keyboard printers for long lines, while for the highest efficiency of trunk-line service—the high-speed automatic, with electrolytic receiving—has advantages which will eventually cause it to be adopted. Indeed, in the opinion of the writer, the ideal service would be the high-speed automatic for trunk lines, with keyboard printers for branch lines and local business.

American Foundrymen's Association.

The tenth annual convention of the American Foundrymen's Association was held at Philadelphia, Pa., May 20-24. Affiliated with the association were the Associated Foundry Foremen and the Foundry Supply Association. The latter organization conducted an extensive exhibit of foundry machinery. The business sessions and the exhibit were held in the Second Regiment Armory. Sessions were held each day, and in the evening, various forms of entertainment were provided. During the afternoons, trips were made to points of especial interest, and in which the foundrymen were particularly concerned.

The address of welcome was delivered at ten o'clock, Tuesday morning, May 21, by Mayor Reyburn, following which brief addresses were made by Thomas Devlin, president of the Philadelphia Foundrymen's Association; Dr. Elmer E. Brown, chairman of the local entertainment committee; W. A. Perrine, president Foundry Foremen's Association; William H. McFadden, president of the American Foundrymen's Association; S. T. Johnston, president of the Foundry Supply Association, and Hugh McPhee, president of the Associated Foundry Foremen. A long list of technical papers was read at the various business sessions.

On Wednesday, May 22, the brass foundrymen, through their representatives to the annual convention of the American Foundrymen's Association, organized an allied association to work in conjunction with the parent organization. Officers were elected for the American Brass Founders' Association as follows: president, J. Faley; secretary, Andrew M. Fairlee, Copper Hill, Tenn.; treasurer, J. H. Sheehan, Philadelphia; vice-presidents, W. R. Webster, Bridgeport, Ct.; W. H. Allen, Stamford, Ct.; W. J. Abate, New York city; Granville G. Wright, Reading, Pa.; J. N. Gamble, Kewanee, Ill.; E. D. W. Richardson, Baltimore, Md.; W. M. Corse, Detroit, Mich.

On Thursday the delegates to the meeting inspected the League Island Navy Yard and several industrial establishments along the Delaware river. A shad dinner was participated in at Washington Park. The remainder of the day was spent at Atlantic City.

On Friday morning a business session was held, at which the following officers were elected; president, Stanley C. Flagg, Jr., Philadelphia, Pa.; first vice-president, C. J. Caley, New Britain, Ct.; second vice-president, John W. Burr, Brooklyn, N. Y.; third vice-president, H. E. Field, Pittsburg, Pa.; fourth vice-president, J. H. Whiting, Harvey, Ill.; fifth vice-president, A. K. Beckwith, Dowagiac, Mich.; sixth vice-president, T. W. Sheriff, Milwaukee, Wis.; seventh vice-president, J. P. Golden, Augusta, Ga.; eighth vice-president, E. L. Anthes, Toronto, Canada. The secretary-treasurer, Dr. Richard Moldenke, was re-elected. Dr. Moldenke and Ex-President McFadden were made honorary members.

The exhibition of the Foundry Supply Association was very extensive, and included many of the prominent manufacturers of foundry machinery. Among those with which electrical devices were related, or which used electricity as motive power, were the following:

Thomas W. Pangborn Company, New York city. This company exhibited air and electrically driven "Hanna" shakers, the new electrically driven shaker attracting a good deal of attention. There were also pneumatic riveters, high and low-pressure sand-blasting machines, and an assortment of molding sands, firing sands and clay products. One of these sand shakers was driven by a one-eighth-horse-power Westinghouse motor connected to an ordinary incandescent lamp socket. This company was represented by John C. Pangborn and Jesse J. Bowen.

The J. S. McCormick Company, Pittsburg, Pa., showed an electrically driven sand mixer. This was an interesting exhibit. The company was represented by John C. McCormick, president; Thomas E. Malone, secretary, and Edward Fahey.

Edward J. Etting, Philadelphia, exhibited the "Dings" electromagnetic separator. This was driven by a small spherical-type motor.

The Cortland Corundum Wheel Company, Cortland, N. Y., exhibited various forms of motor-driven grinding machines equipped with corundum wheels. The company was represented by E. Bertram Pike, secretary-treasurer.

The Chicago Pneumatic Tool Company, Chicago, Ill., exhibited a complete line of air-driven and electrically driven tools. The exhibition of electrical drills and grinders was especially complete, and attracted a great deal of attention from the foundry workers present. The company was represented by H. H. Tripp, W. H. S. Bateman, Fred C. Severn, Thomas Alcorn and Paul Severn.

The Kerr Turbine Company, Wellsville, N. Y., exhibited for the first time the new Kerr steam turbine. This exhibit was in charge of H. C. Remmers.

The Monarch Emery and Corundum Wheel Company, Camden, N. J., exhibited a line of corundum wheels.

The Oliver Machinery Company, Grand Rapids, Mich., made an attractive exhibit of motor-driven machinery. This included band saws, lathes and wood trimmers. The exhibit was in charge of A. M. Spencer.

The New England Engineering and Equipment Company, Boston, Mass., combined with the Northern Engineering Works, Detroit, Mich., showing motor-driven cupolas and electric hoists.

The Yale & Towne Manufacturing Company, New York city, made a striking exhibit of electrically driven hoisting apparatus. This included a two-ton special hoist for foundry control, a twenty-ton chain block triplex hoist, and a one-ton triplex, one-ton duplex and one-ton differential hoist. The exhibit was in charge of H. S. Valentine and C. H. Redfield.

The Wilbraham-Green Blower Company, Philadelphia, exhibited a Green blower driven by a Westinghouse motor. This exhibit was in charge of Thomas W. Green and E. T. Jones.

The Joseph Dixon Crucible Company, Jersey City, N. J., had reception quarters, which, we regret to state, were closed early in the week because of the death of John A. Walker, vice-president and treasurer of the company.

The Rockwell Engineering Company, New York city, exhibited a double-chamber melting furnace driven by a five-horse-power motor; a fan blower driven by a rotary oil pump, and several forms of melting furnaces.

The Cooper Hewitt Electric Company, New York city, exhibited Cooper Hewitt mercury vapor lamps, both for direct and alternating currents. The Cooper Hewitt rectifier was also shown in operation. This company was represented by Walter O. Conley, M. B. Buckman, Jr., and E. D. Hayes.

The Otto Gas Engine Company, Philadelphia, made a striking exhibit of a direct-connected sixty-horse-power engine driving a forty-five-kilowatt Crocker-Wheeler generator. The current for the power plant for the exhibition was furnished by this equipment. In addition to this there was a nine and one-half and a three and one-half-horse-power Otto gas engine, all running on city gas service. The exhibit was in charge of D. A. Marshall, J. C. Edwards, E. Burns, Charles W. Higgins and E. A. Fischer.

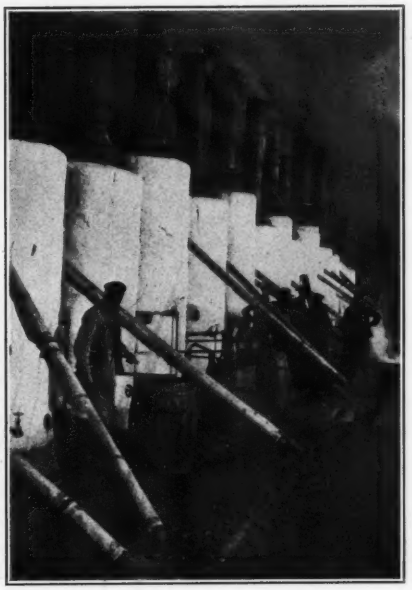
This exhibition was the first large exhibition which has been conducted under the newly organized Foundry Supply Association. All of the exhibitors voiced their satisfaction with the arrangements, and expressed the idea that considerable benefit had been derived through their representation. The affair was notable in connection with the number and value of the souvenirs which were distributed by the various manufacturers.

The Development of the McCall's Ferry Power Company.

Outline of a Mammoth Power Scheme on the Susquehanna River.

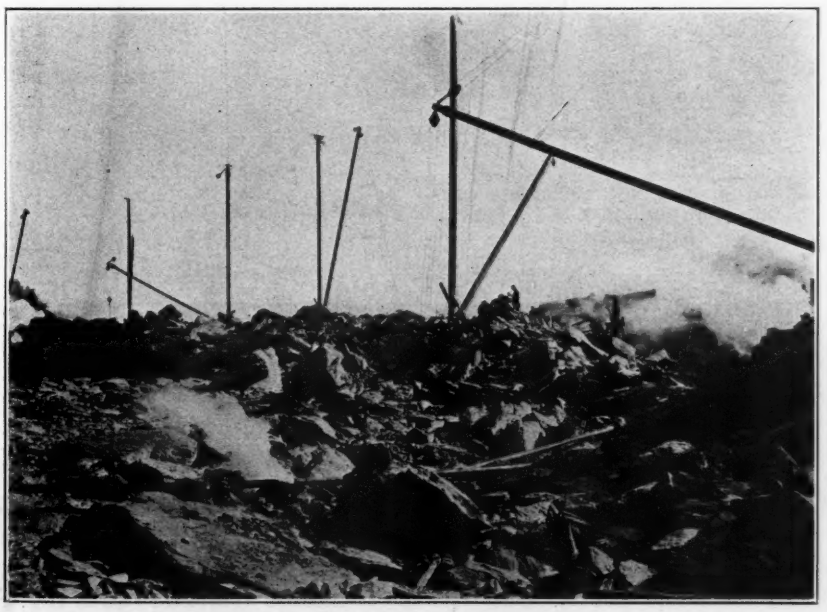
By Day Allen Willey.

THE dimensions of the Susquehanna river, especially the fall in the channel between the city of Harrisburg, Pa., and the foot of its rapids, combine to make it one of the greatest natural water powers in this country. For this reason it seems strange that the opportunity for generating electricity afforded by the river has not been utilized until recent years, for the maximum electrical horse-power which can be secured is such that it rivals Niagara in its extent. One plant of considerable importance has been constructed to generate current from the river, most of the voltage being transmitted to the city of York, Pa., where it is utilized both for illumination and purely industrial purposes. The generating station is located at York Haven, about eleven miles from the city in question. But it is interesting to know that the dam at this site is constructed of masonry, while in later operations lower down on the river advantage has been taken of the concrete structure as a substitute. The York Haven project has a present capacity for supplying about 25,000 horse-power, the generators being direct-connected to turbine wheels in the power-house, which is 478 feet long and fifty-one feet wide, each turbine having a rated capacity of 600 horse-power. The dam in connection with the power-house, as already stated, is constructed of masonry and timber and is 3,000 feet in length.



McCall's Ferry Project. Battery of Boilers for Supplying Steam for Steam-Driven Tools and Other Purposes.

The York Haven plant, however, is of small dimensions compared with what is known as the McCall's Ferry project which is now under way. This is located at a point on the river forty miles from Baltimore, twenty-five miles from York and sixty miles from Philadelphia. At this point the conditions are especially favorable for the construction of a station which will generate a very large horse-power considering its cost, but the dam which is now being built is not only one of the most extensive in the country, but in the world.



McCall's Ferry Project. Removing Rock from River Bed in Preparing Tail-Race.

The river at the point where the dam will cross divides itself into two swift-flowing channels around what is known as Fry island. Just to the north is Tobe's island, and to the south Piney island. The dam is built on bedrock, crossing Fry island about its middle point. The beds of the two channels are very irregular, the depth at some places where the dam crosses being as much as sixty feet, as it is necessary that the dam be constructed on a foundation of solid rock. The height of the wall of the dam from the river bed varies from sixty to 100 feet, while from the surface of Fry island the height is about forty feet, which will also be the height of the entire dam above the normal surface of the river.

The dimensions of the dam are 2,650 feet long in the overflow, or weir length, but as the ends of the dam will extend over the shore on either side, the length will be 3,000 feet. It is sixty-eight feet wide at the base, the lower face curving up in a parabolic form, while the wall facing the up-stream rises perpendicularly. The cross-sectional shape is what is known architecturally as the "ogee" shape. There are zigzag fishways and log chutes constructed on the face of the dam.

The power-house of the plant will be situated on the Lancaster county side of the dam, and will really be built into the dam. It will be eighty feet by 500 feet and will be equipped with ten generating units, each having a minimum normal output of 7,500 kilowatts. The turbines actuating the generators will each have a capacity of 13,500 horse-power. The water which will actuate the turbines will pass through the conduits serving the wheels at the rate of 16,000 gallons a second. This water will be discharged into the old river bed below the dam.

The preliminary construction on this project has been so elaborate that it is well worthy of description. Operations were begun at the site in October, 1905,

consequently the work has been in progress less than two years. To divert the water in the river so that a portion of the site of the structure would be accessible, a coffer-dam of large proportions was required. The formation of the river bed at this point is principally mica schist worn by the action of the current so that the bottom is cut into fissures and gullies, some so large that the water remained in deep pools after the diversion dam was completed, and was only removed with the aid of centrifugal pumps. The temporary barrier was first erected on the Lancaster county side. A series of timber cribs, each sixteen by thirty-five feet in dimensions, were sunk in a row separated by intervals of ten feet, thirty-eight being utilized in all. They were held in position by stone ballast and the openings between them closed with a framework of logs faced with heavy planking. Against the breast of the dam were dumped stone and earth to make it more secure.

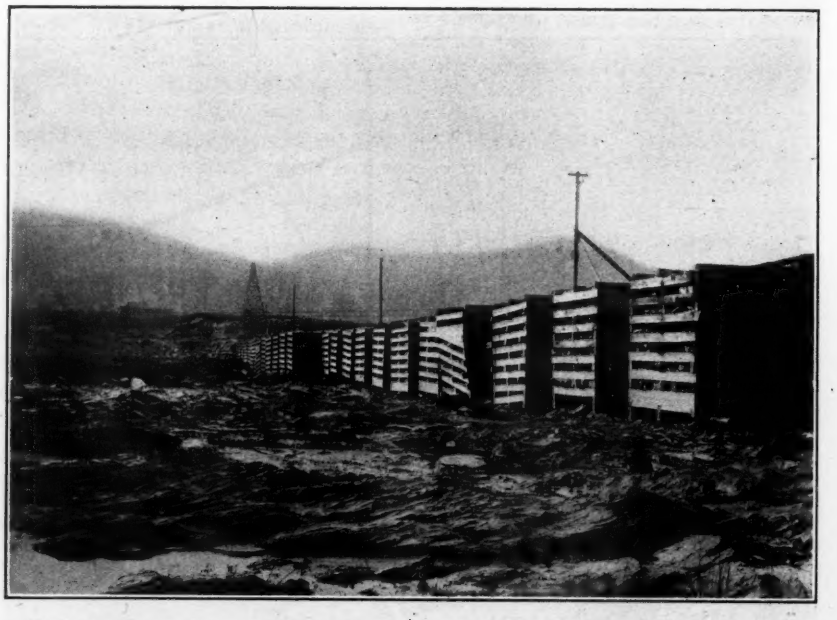
The coffer-dam extended from the north bank of the river to Fry's island. In addition to this, however, the north channel was spanned by a substantial bridge of concrete partly for the transportation of men and material. It was built mainly however, for the tramway on which the series of travelers rest so that they could be moved across the channel as work progressed. In addition to this tramway another was constructed on the bridge for the work and material trains. All of this expensive erection, however, is merely temporary, to be removed when the dam is entirely completed.

The preparation of the river bed for the foundation of the permanent work has necessitated quarrying operations on a large scale, much of the formation to be removed being shattered with explosives. A large quantity of natural stone has been needed for the base on which rest the massive concrete blocks composing the superstructure. To facilitate the work several miles of tramway have been laid upon the exposed bed for conveying material, and this service, with the aid of the traveling conveyers, has greatly reduced the force of laborers who otherwise would be required. As the photographs show, the conveyers are of the bridge tramway type with tilting arms, so that they can be swung over any portion of the dam. As the total quantity of concrete required is over 400,000 cubic yards, an elaborate mixing plant has been installed at the works. Eight Smith mixers, with a capacity of 2,000 cubic yards a day, are in a building 200 feet by fifty feet. The mixers are placed under chutes connecting with bins above, containing the crushed stone, sand and cement used in composition. There are thirty-two of these bins in all. Next to the concrete plant a storehouse for the cement has been erected, for in all over 400,000 barrels will be used.

All the drills and the hoists on the derricks are worked by compressed air. This air is furnished by two 350-horse-power Corliss engines. The engines, which are served by four boilers, have each a sixteen-foot flywheel, with a piston stroke of four feet. In the same engine-house is installed the generator that furnishes the entire works, houses, etc., with current for lighting and telephone service. Near by are the machine and carpenter shops.

At Conowingo, fourteen miles below McCall's Ferry, the company has opened two quarries, giving employment at present to 400 men. The quarries are about a mile apart, one having a rock face 2,000 feet long, and the other a rock face 1,000 feet long. Both quarries are reached by tramways, and the rock as it is taken from the quarries is swung out over the tracks on large cables and then dumped into cars. Thus the stone for the concrete is

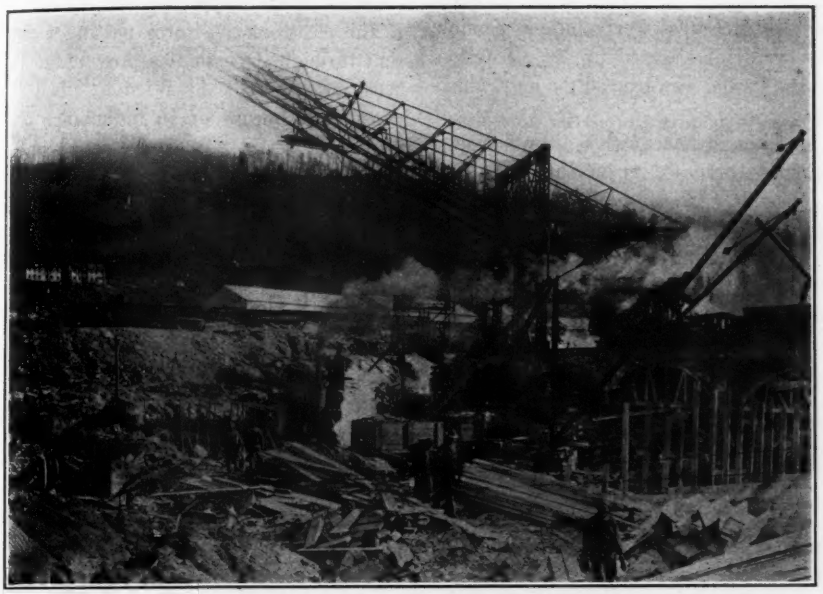
McCall's Ferry Project. Tramway on Bed of River for Handling Material.



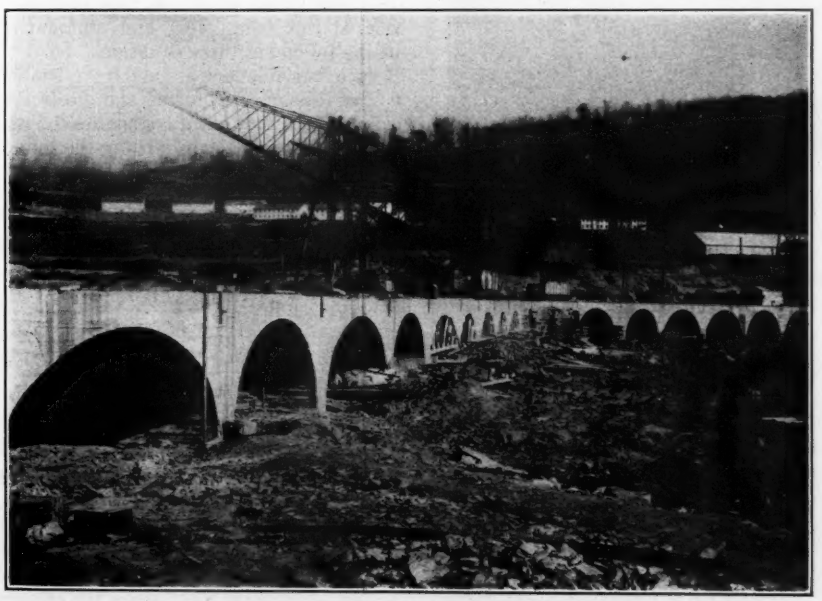
McCall's Ferry Project. Cribs Used in Constructing Temporary Coffer Dam.

obtained. The sand for the concrete is dredged from the bottom of the Chesapeake Bay off Elk river, and brought to Port Deposit on a fleet of ten barges. As soon as it arrives at the company's dock at Port Deposit, it is taken from the barges by two suction pumps and dumped into the waiting cars, which haul it up to McCall's Ferry, a distance of twenty-one miles.

the entire project is to be carried out, the permanent dam being in two sections. As soon as the section under way is finished, another coffer-dam will be built in the south channel and the water diverted to the other side. As the portion now under way is being erected in the form of piers to be closed later by "stop logs," the river will flow through the spaces between these piers left temporarily for the purpose.



McCall's Ferry Project. Working on Foundation of Permanent Dam, Showing Concrete Conveyers, Temporary Bridge and Lancaster County Shore. Also Concrete Mixing Plant on Shore.



McCall's Ferry Project. Temporary Concrete Bridge Erected to Support Conveyers and Construction Railroad.

While the description of operations which has been given is confined principally to the work on the north or Lancaster county side of the Susquehanna, it will give an idea of the manner in which the entire project is to be carried out.

In addition to the labor-saving machinery a force ranging from 2,000 to 3,000 men has been almost continuously at work, except during a few periods when high water caused operations in the river itself to be suspended, consequently at the present time the permanent structure is so far advanced that an idea can be gained of its huge dimensions.

The location is one of the most favorable in the United States for the distribution of electrical current. As has already been stated, the power-house will be but forty miles from Baltimore, sixty miles from Philadelphia and twenty-five miles from York. McCall's Ferry is in the centre of a country using, it is estimated, over 1,000,000 electrical horsepower. Taking McCall's Ferry as the centre of a circle with a radius of forty miles, this circle runs directly through Baltimore and nearly through the cities of Harrisburg, Reading, Pa., and Wilmington, Del. In fact, the plant is adjacent to one of the most thickly settled portions of the country, as well as several of the largest industrial centres. In addition, however, is a network of transportation lines utilizing steam and the electric current at present. A conservative calculation shows that fully a thousand miles of railroad are near enough to the plant to be served with the electric current if arrangements are made. Since long-distance transmission lines are practical for a distance of 200 miles and over, current generated at McCall's Ferry can be furnished for power, light and transportation to a very large area of the eastern portion of the United States. In fact, when the plant is in operation there is no reason why it should not serve as large a territory as the station at Niagara Falls, from which electricity is now being supplied throughout western and central New York, one of the transmission lines reaching as far as the city of Syracuse, a distance of 150 miles from the source of power.

The first important community to secure the benefit of this development will be the city of Baltimore, as the principal illuminating and power company has made a contract to secure current from this source. It will be brought into the city by overhead transmission. The current to be generated is of the twenty-five-cycle type, which is the same as at present utilized in operating the street railway system of Baltimore, which covers over 200 miles of track. Consequently, the current can be used for operating the electric railways in the city and suburbs, and it is probable that eventually the Susquehanna station will be substituted for the present power plants where steam is used entirely for generating current. Electrical experts have calculated that the various railway

power-houses in the city require annually at least 200,000 tons of coal. With the installation at McCall's Ferry it is claimed that current can be generated and transmitted at such a small cost that fully seventy-five per cent of the fuel bills of the railway company can be saved, or about $250,000 a year.

The contract for furnishing current to Baltimore gives the distributing company a right to serve all consumers within a radius of twenty-five miles from the centre of the city, consequently this territory alone will require a very large voltage. There appears to be no reason why many of the manufactories in Baltimore and vicinity at present using steam power entirely will not be operated by electrical energy on account of its economy as compared with steam and its convenience. The consumers in and around Baltimore alone would be more than enough to take all of the current which could be generated by the full equipment at McCall's Ferry as at present planned, but as already stated, the power-house is located in the centre of a very thickly settled country, which is traversed also by a network of railway lines, all possible consumers of the current.

The results obtained at Niagara Falls have undoubtedly been instrumental in attracting the attention of engineers and capitalists to the opportunities afforded by the Susquehanna river. The power which might be obtained at McCall's Ferry, however, was not calculated from an expert standpoint until the year 1901, when George S. Morrison, the noted engineer, made a careful examination of the river, accompanied by measurements showing the average volume of water, the maximum head which might be obtained in a certain distance and other data. In addition to McCall's Ferry other possible sites were investigated by Mr. Morrison, but the former was deemed the most favorable.

As the outcome of this examination a company composed principally of New York and Philadelphia capitalists was formed, taking the title of the McCall's Ferry Power Company. The capital stock was placed at $10,000,000 and preparations begun for carrying out the project, although as already stated, actual work has been in progress for less than two years. The personnel of the company indicates that it has the necessary financial backing to carry its scheme into execution, as the directors include bankers from New York and Philadelphia. The officers of the company are as follows:

President, H. F. Dimmock.

Vice-president, J. W. Kirkland.

Treasurer, William M. Barnum.

Secretary, Harold Ender.

Directors, H. F. Dimmock, William M. Barnum, S. R. Bertron, Carey T. Hutchinson, William Barclay Parsons, Cliny Fish, New York; William M. Canby, R. E. Griscom and J. J. Hope, Philadelphia, and Gardner M. Lane, Boston.

It will be noted that one of the directors is William Barclay Parsons, the noted engineer. Mr. Parsons is also consulting engineer for the company.

McCall's Ferry Project. Section of Completed Base of Permanent Dam.

A Method for the Determination of Electrolytic Resistance and Capacity Using Alternating Currents.

According to Varley, the polarization capacity of an electrolytic cell is constant if the electromotive force passing a current through it be small. Advantage has been taken of this by Wien to offset the capacity by means of an inductance connected in series with the electrolyte, so that this disturbing factor would not influence resistance determinations. An objection to this method is that it is not independent of the frequency of the alternating current employed, even if the electrolytic capacity be independent of this frequency. To get over this objection a method has been devised by A. H. Taylor, which is described in the *Physical Review* (Lancaster, Pa.) for May. In regard to its behavior toward alternating currents, an electrolyte which has polarizing electrodes may be regarded as a resistance in series with a capacity, a second resistance shunting both the resistance and the capacity in some cases. It is possible to balance this combination in a bridge by inserting a shunted inductance in the same arm with the shunted electrolyte, and in this way a perfect telephonic balance may be obtained, independent of the frequency. The method may therefore be used with currents drawn from commercial supply systems, in which harmonics are present. The analytical proof of this method is worked out completely and summarized in the following three equations. In these, R is a variable non-inductive resistance; r_1 the resistance shunting the electrolytic cell; r_2 the unknown resistance of this cell; r_3 the resistance shunting the inductance; and r_4 the resistance of the inductance; a and b the two proportional arms of the bridge, being identical; C and L, respectively, the capacity of the cell and the inductance of the coil.

$$(1) \qquad R = r_1 + \frac{r_3 r_4}{r_3 + r_4}$$

$$(2) \qquad \frac{r_1^2}{r_3^2} = \frac{r_1 + r_2}{r_3 + r_4}$$

$$(3) \qquad C = \frac{L}{a\,b} = \frac{L}{(r_1 + r_2)\,(r_3 + r_4)}$$

A perfect balance is obtainable only when the current density is low. The first equation enables r_1 to be computed. If the calculated value is smaller than that observed, it indicates a leaky condenser action. Equation No. 2 gives the effective electrolytic resistance, and No. 3 may be used for computing the apparent capacity. This method may also be used for comparing capacities as large as 100 microfarads with relatively small inductances, and it might possibly be used for determining the capacity of condensers which show a large absorption.

WIRING PLANS FOR HEATING DEVICES.

BY F. M. FEIKER.

One of the most important features relating to the introduction of heating devices, interesting alike to the central station manager, the wiring contractor and the home builder, is the arrangement of the various electric circuits. There are three general plans for wiring houses for electric heating devices, differing principally in relative costs of installation. Of these, the first includes the most complete system, made up of separate heater circuits to the bath-room, sewing room, dining room, etc., all radiating from a single location and measured on a separate meter from that employed for lighting. The second class of wiring combines the use of lighting circuits with a separately metered, heavier-wired circuit from which current can be drawn for the operation of the larger cooking utensils at least in the kitchen and laundry. The third and simplest plan makes use of lighting circuits provided with proper outlets at various points throughout the house. In general these various wiring plans are adopted in accordance with the cost of the residence. The percentage cost of each installation of a certain class is but a small amount in comparison with the total cost of the dwelling.

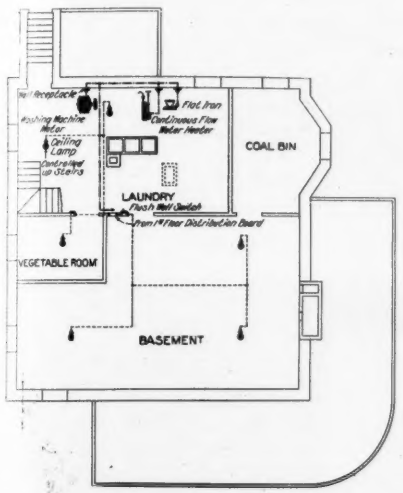
Even for the least expensive modern residence, it is surprising what a number of heating devices can be operated on the ordinary lighting circuits. Flat-iron, chafing-dish, coffee percolator, curling iron, baby milk warmer, shaving mug, small water heater, heating-pad, cigar-lighter, etc., are all well adapted for the purpose. It is reasonable to suppose that all moderate-priced houses would be most likely to make use of this first class of wiring, since the additional cost above the charge of electric light wiring is not prohibitive for the builder.

For the more expensive residence, costing from $5,000 to $7,000, the addition of one or two heater circuits permits the utilization of all the electric heating devices now on the market. Primarily, the heavier heating circuit is installed to operate the larger cooking devices in the kitchen. Cooking and baking outfits for such purposes, neatly combined with tables, wired and fitted with indicating switches, are available in a variety of forms. Two such outfits are furnished by the General Electric Company, one consisting of a two-quart cereal-cooker, two-quart tea-kettle, coffee percolator, seven-inch fry-pan, broiler, grid and oven, is suitable for a family of four, while a somewhat more complete outfit, comprising the same devices, together with a four-quart tea-kettle, ten-inch fry-pan and four-quart vegetable boiler, is large enough for a family of seven.

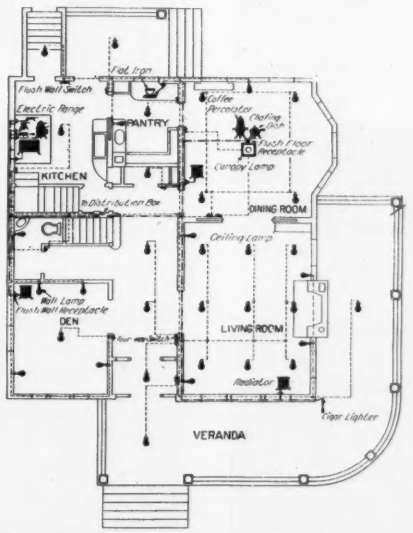
For the third class of heating device wiring, all the heating devices may be adapted which have before been mentioned, as well as electric radiators and water heaters for hot-air and water supply. Providing the cost of wiring is not disproportionate to the cost of the house, this method is by far the best, since all the devices can be operated on a separate meter, and the convenience of the electric method of lighting, cooking and supplementary heating can be realized to the full.

Heating circuits for the kitchen, laundry, bath-room and living rooms should be installed, so that electric radiators and water heaters in the larger sizes can be operated conveniently in any of these rooms.

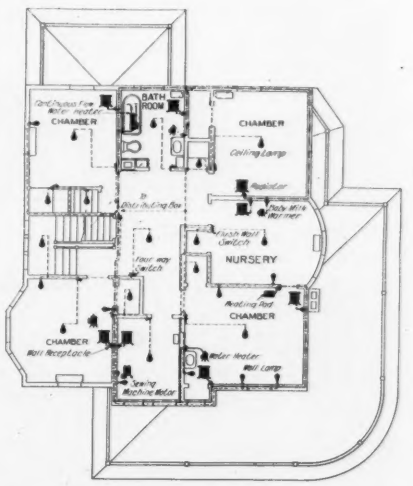
Before taking up in detail several examples of homes illustrating the various systems of wiring, a résumé of the National Electric Code Rules governing the installation of electric heating devices on circuits of less than 300 volts potential will be serviceable. Too much emphasis can not be laid on the importance of strict adherence to these rules. Outlets on electric lighting circuits should be used in accordance with Rule 21, Section d, the phrase "devices which are drawing current" having special bearing on this method of wiring.



BASEMENT WIRING PLAN OF J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.



FIRST FLOOR WIRING PLAN, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.



SECOND FLOOR WIRING PLAN, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

Rule 17—The service of a heating circuit must consist of a cutout which will protect the service switch and the rest of the circuit.

This cutout must have a fuse for each leg of the circuit.

Rule 14, *Section a*—No wire of such circuit may be smaller than No. 14 B. & S.

Section c—If the wires are greater than a No. 8 B. & S., they must be soldered into lugs on all terminal connections. All joints in the circuit must be soldered, whatever size of wire is used.

Rule 21, *Section a*—The cutout must be placed as near the point at which the service enters the building as it is possible to place it.

Section b—A cutout must be placed in the main circuit wherever there is a branch of smaller wire than that of the mains, unless the fuses in the cutout which pro-

tects the mains are small enough to be within the limits of the maximum capacity of the small wire circuit.

Section c—Cutouts must be accessible in plain sight or in an approved cabinet. Link fuses may only be used on slate or marble bases placed in cabinets.

Section d—No circuit on which there are incandescent lamps or both lamps and electric heaters may have more than 660 watts on it, when all the outlets are provided with devices which are drawing current. Such a circuit must be provided with a cutout, the fuses of which shall not be larger than six amperes for 110 volts and three amperes for 220-volt systems.

Section e—Fixture arms may be wired with No. 18 B. & S., the carrying capacity of which is three amperes. (Rule 16.)

Therefore, no electric heater of greater capacity than three amperes may be attached to a fixture, and if the fixture has a key socket, the heater shall not take more than one and one-half amperes at 110 volts or three-quarters of an ampere at 220 volts, as the switch in a key socket will not break larger currents than these.

Keyless sockets, however, are good for six amperes, 110 volts, and three amperes, 220 volts, and so heaters of this capacity may be attached to them, provided the socket is connected to the circuit by a conductor equal to a No. 16 B. & S. for 110 volts or a No. 18 B. & S. for 220-volt systems.

Rule 22—Switches for heater circuits must be double pole when the energy taken is over 660 watts.

Rule 23, *Section a*—It is recommended that an incandescent lamp be connected in multiple with an electric heater, so that it may be a signal to show when the current is turned on.

A circuit for one or more electric heaters must be provided with a cutout, and each heater must have a switch which will indicate whether the current is on or off. If each heater is connected with a smaller wire than used in the main heater circuit, then the cutout required by Rule 21, Section b, must also be supplied. The signal lamp for each heater should also be controlled by the switch.

Section b—The electric heaters must be in plain sight.

Section c—The flexible cord used to supply current to flat-irons and all electric heaters of over 250 watts capacity must be made to conform to Rule 45, Section g.

Section d—Portable electric heaters must have an approved plug so that the strain on the cord will not pull out the plug. The cord must also be connected at the point of connection with the heater, so that it will not become chafed or kinked.

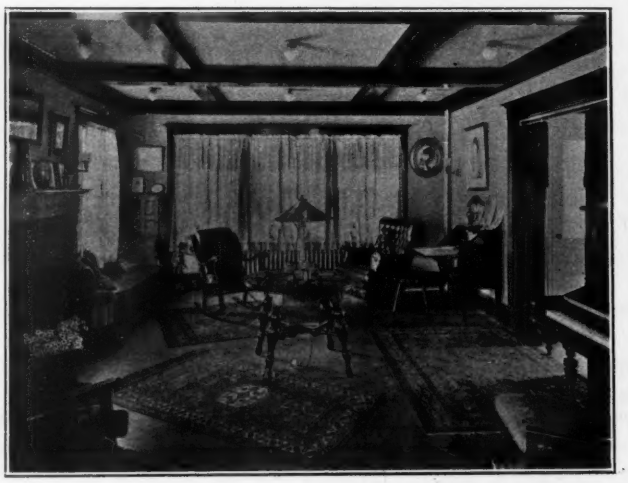
Section e—Flat-irons, etc., must have an approved stand on which they should be placed when not in use.

Inspection department may require flat-irons to have an automatic cut-off if it deem it advisable.

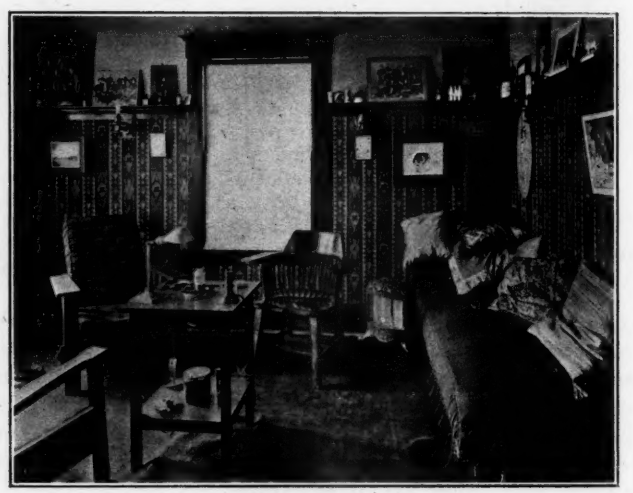
Section f—Stationary electric heaters must be treated as source of heat, and therefore must be installed with the proper

EXTERIOR VIEW, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

DINING ROOM, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.



LIVING ROOM, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.



DEN, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

protection of surrounding inflammable material.

Section g—All electric heaters must have a plate attached to them giving the normal capacity of the devices in amperes and volts, and also the maker's name.

Rule 24—The running of heating circuits, the kind of wire and the supports for same must be according to the wiring Rules 14 to 17 and 21 to 82 inclusive.

Rule 28, *Section d*—Flexible cord as regularly made for drop-lights must not be used for electric heaters.

Reinforced flexible cord may be used for heaters of less than 250 watts capacity.

Rule 45, *Section g*—Flexible cord for heaters of over 250 watts capacity must be made as described in this rule.

The capacity of unfused screw shell attaching plugs on the market which are rated at three amperes, 250 volts, when used for heaters, is limited by the size of the largest approved heater cable which will enter the hole and allow of the usual knot being tied in it.

ELECTRIC KITCHEN, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

BEDROOM, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

BATH-ROOM, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

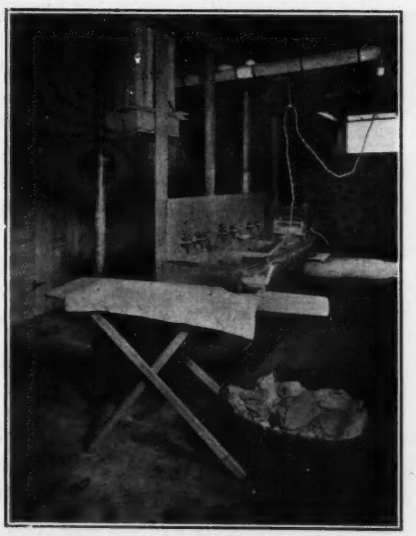
WIRING A $10,000 HOUSE.

Taking up now a specific instance of the first class of wiring for heating devices using several heating circuits as well as many outlets on the lighting circuits, the house of J. E. Davidson, of Montpelier, Vt., may well be taken as an example. The wiring plans of this residence as well as some interior views of the excellent electrical arrangements are shown in the accompanying illustrations.

The main supply wires for both heating and lighting for the house enter the attic, where is located a main double-pole switch and 100-ampere fuses. Two circuits lead from this point, one for heating and one for lighting, each fused for seventy-five amperes.

Branching from the lighting mains are two sets of wires, one to the Edison plug cutouts, which control the five circuits for the second floor, the other to the distribution for the first floor and basement lighting. The distribution box consists of a General Electric Company's eight-circuit, two-wire, double-branch cabinet, enclosed in one of the same company's oak panels, with glass door, and located in the hall off the kitchen, which leads also from the front hall, is a similar cabinet, from which all the heating circuits are distributed, this cabinet, however, being a fourteen-circuit board. Running to this board from the fuses in the attic are two single 0 B. & S. gauge wires.

One receptacle is wired in the baseboard of each of the following rooms: living room, dining room, den, sewing room, all bedrooms, nursery and bath-room. Into these receptacles, any sort of an electrical appliance can be plugged, as a common plug is used throughout. In the sewing room there is an extra circuit, on which may be used a sewing-machine motor or a flat-iron for pressing. Near the bed, in the two front bedrooms, Edison flush plug receptacles are wired in, so that electric heating pads may be connected for use in cold weather for warming the beds, or in case of sickness may be used instead of the heavy and leaky hot-water bag. To the extra receptacle in the bath-room can be attached electric devices for heating water for shaving and other purposes.



LAUNDRY, J. E. DAVIDSON'S HOUSE, MONTPELIER, VT.

One circuit with a capacity of two kilowatts runs to the laundry, to be used either for heating water or for a motor

to furnish power to a washing machine or ice cream freezer.

The common plug and receptacle is an invaluable convenience, as any appliance can be used in any room; for instance, the chafing-dish in the dining room, den, or the bedroom.

The receptacles are installed, generally, so that a radiator can be attached, to take the chill or dampness from the rooms, when the furnace is not running, but they are, of course, frequently used for other purposes.

The kitchen contains the most complete assortment of cooking devices. The kitchen outfit consists of a stained wood table, forty inches long and twenty-four inches wide, with a shelf, on which rests the oven, a few inches above the floor. Back of the table is fastened a board, twelve inches high, mounted on the face of which are seven indicating switches. The first switch to the left, indicating only "on" and "off," controls all the switches, except that connected to the oven. The second indicating switch has four positions: "low," "medium," "high" and "off," and it is used on the oven. This oven cooks exactly the same as any oven in a first-class stove, and has the advantage of allowing three different heats to be obtained by a mere throwing of the switch. Three of the remaining switches on the back board give three heats, and the other two indicate only "on" or "off." Each of these switches is connected to a single twine cord, which is made unusually strong and pliable, and on the ends of the cords are connecting plugs, for attachment to the appliances, the plug being pushed into the receptacle on the utensil.

The flexibility of the electric service lends it to many purposes in this modern house. As may be seen from the description, the various heating outlets have been located in the most convenient positions with reference to the service they perform. A flush Edison plug, located in the floor beneath the dining table, can be employed for connecting heating devices, such as the coffee percolator or chafing-dish, when it is desired to use them on the table. Similarly in the den two flush floor receptacles are installed, one being used for a cigar-lighter and the other for a portable reading lamp. The photographs and wiring plans which accompany this article indicate clearly not only the excellence of the electrical arrangements, but the unobtrusive way in which both lighting and heating by electricity have been combined to form one of the most pleasing and at the same time the most practical features of this, a modern home.

Annual Convention of the International Independent Telephone Association.

The annual convention of the International Independent Telephone Association will be held at the Auditorium Hotel, Chicago, Ill., June 3, 4, 5 and 6. A good meeting is expected, as under the plans now followed a full attendance of delegates from the state organizations is guaranteed. The entertainment features have not been overlooked, and already a number of exhibitors have decided upon representation. The following programme has been announced:

JUNE 3.

10.30 A. M.—Meeting of committees: Physical Standards, Standard Forms of Accounting, Standard Operating Rules and Regulations.

1.30 P. M.—Meeting of executive committee.

2.30 P. M.—Meeting of advisory board.

JUNE 4.

10 A. M.—Meeting of committees in charge of details: Arrangements, Entertainment, Reception, Registration, Sergeants-at-Arms.

2.30 P. M.—Convention called to order. Address of welcome, the Hon. F. A. Busse, mayor of Chicago; response, H. D. Critchfield, Milwaukee, Wis.; president's annual address, James B. Hoge, Cleveland, Ohio; officers' reports; appointment of committees; short talks on practical subjects: "Construction Problems," "Shield Advertising," "Collection Methods."

Open discussion, Question Box.

Adjourn for the day.

Outing at Sans Souci Park.

MORNING SESSION, JUNE 5.

10 A.M.—Committee report, "Entertainment." Discussion and action. Written reports of state, territorial and provincial associations.

General discussion, "The Long-Distance Business:" (a) "How to Handle It," Frank Hart, Pittsburg, Pa.; (b) "Independent Improvements and Possibilities," C. E. Tarte, Grand Rapids, Mich.; (c) "Long-Distance Advertising," W. J. Stadelman, Sioux City, Iowa; (d) "The Toll Line Clearing House," J. M. Plaister, Fort Dodge, Iowa.

Adjourn for lunch.

AFTERNOON SESSION, JUNE 5.

2 P. M.—Committee reports: "Standard Forms of Accounting," "Standard Operating Rules and Regulations." Discussion and action.

"Lest We Forget," Col. J. D. Powers, Louisville, Ky.

"Compulsory Interconnection of Bell and Independents," J. B. Earle, Waco, Tex.; J. Walter Barnes, Fairmont, W. Va.; O. C. Snider, Kansas City, Mo. Discussion.

"Post-Office 'Phones and the Washington Situation," Chas. E. Sumner, Portland, Ore. Discussion.

"Telephone Securities as an Investment," W. L. Moellering, Fort Wayne, Ind.

"Frenzied Finance in the Telephone Field," Dwight E. Sapp, Mt. Vernon, O.

"Where the Copper Comes From," J. S. Haley, Livingston, Mont.

Question Box. Adjourn for the day.

Informal banquet, 7.30 P. M., in the banquet hall, Auditorium Hotel, C. W. Kline, Hazleton, Pa., toastmaster. Music and special programme.

MORNING SESSION, JUNE 6.

10 A. M.—Committee report, "Physical Standards." Discussion and action.

"Rural Telephony—Its Value to the Community and Relation to the Independent Movement," C. H. Schweizer, La Crosse, Wis.

"Making History in the Canadian Northwest," Francis Dagger, Winnipeg, Manitoba.

"The Strength of the Chain," James S. Brailey, Jr., Toledo, Ohio.

"The Indiana Situation," Chas. S. Norton, Indianapolis, Ind.

Question Box. Adjourn for lunch.

AFTERNOON SESSION, JUNE 6.

2.30 P. M.—Reports of outstanding committees; report of nominating committee. Discussion and action.

Election and installation of officers; transaction of miscellaneous business; presentation of new business.

Question Box. Convention adjourns.

The following companies will exhibit apparatus in the rooms indicated by numbers herewith:

642—American Electric Fuse Company, Muskegon, Mich.—protective devices. 134—American Electric Telephone Company, Chicago, Ill.—switchboard, telephones and parts. 618—American Steel and Wire Company, Chicago, Ill.—wire and cable. 650—American Sewer Pipe Company, Pittsburg, Pa.—underground clay conduit. 601-2—Automatic Electric Company, Chicago, Ill.—automatic telephones and systems. 610-12—Belden Manufacturing Company, Chicago, Ill.—wires, cords, etc. 136—Carnahan-Sherwood Company, Indianapolis, Ind.—accounting systems, blank books and forms. 616—Central Telephone and Electric Company, St. Louis, Mo.—telephone apparatus, protective devices and specialties.

659—Century Telephone Construction Company, Buffalo, N. Y.—switchboards, telephones and parts. 648—Chance Manufacturing Company, Centralia, Mo.—lightning arresters. 620-22-24—Chicago Telephone Supply Company, Elkhart, Ind.—switchboards, telephones and parts. 604-6—Frank B. Cook, Chicago, Ill.—terminals, protective devices and accessories. 638—Durant Electric Supplies Company, Chicago, Ill.—telephone and electric material. 662-64—Electric Appliance Company, Chicago, Ill.—switchboards, telephones and accessories. 608—L. M. Ericsson Telephone Manufacturing Company, Buffalo, N. Y.—switchboards, telephones, parts and novelties. 656—Eureka Electric Company, Genoa, Ill.—switchboards, telephones and parts. 610-12—Homer-Roberts Telephone Company, Chicago, Ill.—party-line lockout systems. 613—Indiana Steel and Wire Company, Muncie, Ind.—wire. 102—International Telephone Manufacturing Company, Chicago, Ill.—switchboards, telephones and parts. 644—W. N. Matthews & Brother, St. Louis, Mo.—anchors, cable-stringing apparatus and specialties. 611—Miller Anchor Company, Norwalk, Ohio—anchors. 130-32—Monarch Telephone Manufacturing Company, Chicago, Ill.—switchboards, telephones and parts. 104-6—National Pole Company, Escanaba, Mich.—poles. 628—W. G. Nagel Electric Company, Toledo, Ohio—telephone and electric supplies. 652—National Carbon Company, Cleveland, Ohio—batteries and carbon specialties. 640—North Electric Company, Cleveland, Ohio—switchboards, telephones and parts. 660—Nungesser Electric Battery Company, Cleveland, Ohio—batteries and specialties. Writing Room—Sterling Electric Company, La Fayette, Ind.—reception room for entertainment of guests. 637—Select Telephone Manufacturing Company, Springfield, Ohio—telephones and lockout systems. 634-36—Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.—switchboards, telephones and parts, wire and cable. 632—Swedish-American Telephone Company, Chicago, Ill.—switchboards, telephones and parts. 646—Telephony Publishing Company, Chicago, Ill.—telephone literature. 609—Universal Pole and Post Preserving Company, Circleville, Ohio—pole preservative, specimen treatments. 614—Vote-Berger Company, La Crosse, Wis.—anchors, switchboards, telephones and parts. 639—Western Telephone Manufacturing Company, Chicago, Ill.—telephones, parts and accessories. 647—Wire and Telephone Company of America, Rome, N. Y.—long-distance hand telephones and rubber-covered wire. Parlor Floor—Dean Electric Company, Elyria, Ohio—switchboards, telephones and parts.

ELECTRIC TRUNK LINE OPERATION.

PAPER AND DISCUSSION BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of the American Institute of Electrical Engineers held in New York city on May 21, Frank J. Sprague presented a paper entitled "Some Facts and Problems Bearing on Electric Trunk Line Operation." This paper gave a summary of the present situation in electric railway development with respect to heavy traffic, and discussed, from the author's point of view, the relative merits and demerits of the different systems and appliances.

The author first called attention to several recent statements by railway officials, which dwelt upon the great need of increasing the traffic facilities of the railroads of this country, and said that electrical operation was being seriously considered. It is said that the total of the outstanding stocks, bonds and other obligations of the steam railroads in the United States now aggregates $13,000,000,000. Similar obligations of the electric roads to-day exceed $3,500,000,000.

Mr. Sprague recalled a statement of his, made fifteen years ago in Chicago, in which he expressed the hope for a single-circuit, alternating-current motor drawing power from an overhead conductor practically rigid in character, which might solve the problem confronting the electrical engineer. His position in this problem has not altered, but the problem has become more of a financial than a technical one. It narrows itself down to the one question as to the number of trains operated between the two terminal points. Make that number sufficiently large, and the electric motor is the best means of propulsion; decrease this, and steam is to be preferred. Electricity is no panacea for railroad ills, and deductions based on general averages are not safe guides. Statistics governing the operation of all the railroads of the country may seem to show that there would be a saving by entire electrification, but there are many roads not at all suitable for this change, and the showing made by averages therefore reduces the apparent advantages of electrifying those roads for which the conditions are suitable.

The author epitomized certain conclusions with regard to electrification which he believes will bear the test of time. Briefly, they are as follows: If increased economy be deemed the dominant reason for change of motive power, every wheel on an electrified division should be turned electrically. Increase of capacity will ordinarily be the more potent influence in leading to the adoption of electric traction. Every road is a problem which must be considered on its own merits. The adoption of electricity would ordinarily begin where traffic is comparatively dense. Terminal properties in great cities offer an immediate field for the serious consideration of electrification. There can not now be safely established any final standard, or single system selected, as the best for all roads. What is the best for one might easily be less advantageous for another, and there is no valid reason why any road should adopt something fitting to a less degree particular requirements, because of the action of some foreign road.

Mr. Sprague then discussed the various factors in electrification, beginning with the motor equipment. He took up the limitation of design with reference to the different types of motor, and compared motors of these types with one another. He deduced figures showing especially the relative standing of the single-phase, alternating-current motor and the direct-current motor, selecting two machines of approximately equivalent weight. The direct-current machine was rated at 240 horse-power for one hour; the alternating-current, twenty-five-cycle motor at 125 horse-power. He then deduces for these motors what he calls the weight coefficient, obtaining this by dividing the nominal rated horse-power by the revolutions per minute multiplied by the weight in tons, and shows that for different periods of time required to raise the temperature of the motor seventy-five degrees, the coefficient for the direct-current motor is from two to four times as large as that of this particular single-phase motor. Attention is called then to the possible improvements in the direct-current motor, particularly in adapting it to higher voltages, and a summary is given of the characteristics of the two types, the great number of these being, in the opinion of the author, in favor of the direct current.

Electric braking is discussed at some length. This may be accomplished by returning power to the line, or simply by short-circuiting the motor on a resistance. The advantage of the first is the great reduction in power consumption effected, but there is a disadvantage, in that it is not so easily controlled, and when running down-grade, where the system would be most useful, careful adjustment of the braking controller is necessary, and read-

justment is needed whenever the air-brakes are applied. An application of the brakes without adjustment of the controller may cause the motors to draw power from the line instead of returning it. The other system is simpler, and independent of the air-brake system. It also relieves the mechanical brakes, and could be used to advantage on long trains, where the slowness of the air-brake occasionally gives trouble.

The different types of conductor are next taken up, somewhat in detail, particular reference being made, however, to the protected third rail and to the catenary suspension of high-voltage trolleys. It is held that all working conductors are in many ways objectionable, but they are, of course, a necessity. The third rail is an inert structure, is not under strain, can be lined accurately with the track, and its expansion readily taken care of. The overhead trolley is necessarily a system under strain, and where permanency is desired, it must be carried by one or more catenary cables, which, on roads of high curvature, make the construction more difficult. The third rail offers some hindrance to the ordinary maintenance of track, but the overhead construction is inelastic. The laying of additional tracks calls for expensive alterations in the overhead structure. Derailments will crush the third rail to the ground, but may, as well, bring the entire overhead structure down.

After a brief reference to the early proposals for alternating-current operation, Mr. Sprague describes a number of well-known locomotives which have been constructed or proposed for heavy traction work. Among these are the New York Central locomotive, using direct-current, gearless motors; the New Haven, using alternating-current, gearless motors; the Valtellina and Simplon locomotives, and the Ward Leonard system, in which a motor-generator set driven by a single-phase, high-voltage motor is carried on the locomotive and supplies low-potential direct current to the driving motors. An equipment of this kind may be placed on a separate vehicle drawn as a tender to an ordinary locomotive. This has an advantage, in that a breakdown to either unit does not throw the other out of service.

The author briefly touches upon what he considers the necessity for standardizing generators. If the voltage be carried too high, the machine becomes expensive and heavy. Moreover, high voltages are attained in generators only with difficulty. This is not true of the static transformer, and he is in favor of a low-voltage generator using step-up and step-down transformers to obtain the necessary high voltage for transmission, and low voltage for utilization.

A general comparison is made of the cost of direct-current and single-phase, alternating-current systems, specific figures, however, not being given. Each must have a central station generating alternating currents delivered to step-up transformers. The direct-current system calls for a three-phase station; the other for a single-phase, so that the cost of the former will be somewhat less. Substation transformers must be provided, costing approximately the same for both systems; but the converters and necessary housing and switching apparatus create an excess cost chargeable to the direct-current system. The working conductors will cost approximately the same, the alternating-current system frequently being the more expensive. Track bonding will be somewhat more expensive for the direct-current system. The remaining element is the locomotive and motor-car equipment. Mr. Sprague believes, from every standard which he has been able to compare, that the cost of this part of the equipment with a twenty-five-cycle, alternating-current motor is so much higher than with direct-current motor equipments that it is a debatable question whether the increased cost and cost of operation will not fully offset the cost of the synchronous converters and the losses in their operation. He has previously compared a twenty-five-cycle locomotive with a fifteen-cycle locomotive, and decided that the former is the lighter and less expensive machine.

Although Mr. Sprague does not think that the single-phase, alternating-current system, as now proposed, will have the wide application which its advocates urge, he admits that there is a field for it. This, he believes, is on roads of considerable extent, which operate an irregular and sparse traffic, where only moderately expensive, or what may be called a second-class overhead construction, is tolerable on account of the expense. As one departs from this condition, adopts more permanent construction, and faces the problem of denser traffics and higher capacities, any advantages of the single-phase system will disappear, and the superiority of the direct-current system becomes manifest. He believes, however, that there is at present no single system which can be selected as best for all purposes; that a wide and increasing use of each will be created, and in the greater number of cases, a compromise selection of the best elements of alternating and direct-current practice will obtain. While there are many things in railroading which have been standardized, and others which can now very properly be, railway officials will consider the problems involved in changing their systems from individual standpoints, and will demand from manufacturers all possible freedom from restriction when exercising their own judgment as to the adoption of any system. The most satisfactory system will be that one which will permit continuous all-around operation under such conditions as will utilize to the utmost all the beneficial features of electric application.

W. J. Wilgus, first vice-president of the New York Central & Hudson River Railroad, opened the discussion, saying that he agreed with much that Mr. Sprague had said. He feels certain that all steam railroad officials are now looking upon the future possibilities of the electrification of steam railroad traffic with keen interest and with a full appreciation of the magnitude and dignity of the problem. But there will be no sudden general substitution of electricity for steam as a motive power any more than there was a sudden jump from the small locomotive of the De Witt Clinton type to the Mallet compound of to-day. The first movement in this process of evolution will be the substitution of electricity for steam in congested passenger terminals at large centres of population, where the public demand a cessation of nuisances incident to steam locomotives, and where the increasing volume of traffic requires increased capacity that can not be secured by present motive power. Coincident with the change of motive power in crowded passenger terminals is coming the use of electrically propelled trains on existing steam railroad tracks between large centres of population where frequent units are necessary to accommodate the public. In addition to these instances where at this time the wisdom of the adoption of electricity as a substitute for steam is self-evident, there are a number of places in the West where the capacity of steam locomotives of the highest type is entirely inadequate to handle freight traffic on the pusher grades, and the only manner in which the increased capacity can be obtained is by means of electricity. With a start in the substitution of electricity for steam in the operation of congested terminals, connecting lines between large centres of population and long pusher grades with heavy freight traffic, we may look with

confidence to a gradual expansion of the use of the new motive power in other directions. For example, in the case of the New York Central the primary object of the use of electricity was to abate the smoke nuisance in the Park avenue tunnel and increase the capacity of the Grand Central terminal. When this decision was reached it became self-evident that the use of the motive power should extend to the end of the suburban territory at Croton on the Hudson division, a distance of about thirty-five miles. While the northerly terminus of the main line is thus planned for the present at Croton, it is probable that just as soon as the developments in the electrical field will warrant such action, the electric zone will be extended as far as Albany, a total distance of 142 miles. He strongly endorsed Mr. Sprague's remarks on the wisdom of adopting the multiple-unit system for handling suburban service. The New York Central has already reaped its reward in adopting this method in the elimination of practically all of the delays of train service at the Grand Central Station that heretofore largely resulted from the multiplicity of movements of steam locomotives in passing to and from the engine house facilities and in switching from the head to the rear end of trains; in fact, apart from other improvements made at this terminal, the use of the multiple-unit system has at this time resulted in an increase in the capacity of the station of at least thirty-three per cent. Moreover, the rapid acceleration of this character of equipment as compared with locomotive practice has resulted in the ability of the operating department to maintain schedules with a reduced rate of speed between stations. Always having in mind the primal elements of safety and reliability, all inventive genius of the great manufacturing corporations in this country should be bent on devising means of accomplishing a desired result at less cost. One of the promising movements in this direction is the hints that have been given of the possibility of substituting for the expensive rotary converters and substation attendance with the direct-current system, a very simple device which will cost very little and require no attendance. This one feature, if successful, will go far toward strengthening the hand of the steam railroad enthusiast in extending the use of electricity more generally than now seems possible. The signal field is also one in which there is room for improvement in reducing costs of installation so as to make the use of electricity feasible from a financial standpoint.

L. B. Stillwell said that the significance of the estimates of comparative operating costs, given in the paper presented recently before the Institute by H. St. C. Putnam and himself, is that the results, viewed in connection with admitted facts in respect to increased earnings, indicate that a general electrification of important railway divisions, and even of trunk lines, is coming much more rapidly than has been realized, even by electrical engineers; and the lesson to be drawn from this conclusion is that we must standardize as promptly as possible everything essential to convenient interchange of rolling stock. For interurban service he will probably continue to use the direct-current system for some time to come, but for trunk line operation the fifteen-cycle, alternating-current, single-phase system possesses inherent characteristics which, in this class of work, constitute controlling advantages as compared with any direct-current system that has been suggested, or is liable to be developed to an operative condition. He criticized Mr. Sprague's paper for comparing two motors of equal weight. This is unfair to the alternating-current motor as it takes advantage of the fact that increase in the size of motors of any type, alternating current or direct current, implies reduction in weight per horse-power. Had the comparison brought together two motors of equal type the ratio of weights would have been far less than is the ratio of output when equal weights are considered. Moreover, the comparison is made with a 550-volt direct-current motor weighing, without gear, gear-case and pinion, only 23 pounds per horse-power. This is extraordinarily light, and indicates that the motor is, in respect to the relation of weight to output, superior to anything in general use. The latest 200-horse-power motors offered within the last sixty days to the Interborough Rapid Transit Company by the leading manufacturers weigh, respectively, 28 and 30 pounds per horse-power. The alternating-current motor referred to, on the other hand, is characterized by a higher ratio of weight to output than other single-phase motors of comparable output in the market. The comparison is between a direct-current and an alternating-current motor operating at twenty-five cycles, not fifteen cycles, which is the frequency suggested by Mr. Putnam and himself. The twenty-five-cycle motor has a far higher ratio of weight to output than fifteen-cycle motors of the same output. The direct-current system is handicapped by the converter substations, and he knows enough of the cost and limitations of these to realize that for trunk line railroad operation in the broad sense a system which employs the converter as an essential link between the coal pile and the train must give way to a system which eliminates this link, provided the single-phase alternating-current motor is designed and manufactured with anything approximating the care which to-day is bestowed upon the direct-current motor. Bearing on the relative size and weights of the two systems are some figures obtained recently from the engineers of one of the leading manufacturing companies for a specific installation. These figures relate to fifteen-cycle, single-phase, alternating-current motors of 200 horse-power at a one-hour rating and 600-volt direct-current motors of the same output. These motors are practically identical in speed when delivering 200 horse-power. The maximum vertical dimension of the alternating-current motor is 36½ inches, that of the direct-current motor 1⅝ inches less. The weight of the alternating-current motor is 6,280 pounds, that of the direct-current motor 6,000 pounds; both of these weights are exclusive of gear, gear case and pinion. The alternating-current motor requires a wheel base one foot longer than is necessary with the direct-current motor. The ratings in the case of both motors are based upon the same rise of temperature without forced ventilation.

When we come to consider the auxiliary car equipment and wiring there is a very radical difference in favor of the alternating-current system. In this field, as in the lighting field, the transformer is the key to the solution of the general problem of transmitting energy at reasonable cost and utilizing it at safe and easily controlled potentials. Recent estimates he had made for a particular case showed a saving in cost of 50 per cent in favor of the single-phase system when compared with a 1,500-volt direct-current system.

W. B. Potter, of the engineering department of the General Electric Company, said that for a number of years the direct-current motor was made principally with respect to its mechanical features. Within the past year or so there has been made a distinct and radical improvement with respect to its commutation, and direct-current motors having commutating poles will undoubtedly be the type of direct-current motor to be used in the future. In fact, a number of thousand of such motors are already being manufactured on

orders received and many others are in contemplation. One of the particular difficulties with a single-phase motor has been commutation—that has been the feature which has limited its capacity, which has decreased its reliability and caused the greatest amount of study on the part of designing engineers. Also by reason of the difficulties with commutation, the armature speed has been considerably higher. All of these features have tended to make the motor less desirable as a motor than the direct-current motor. He was pleased to say he believed without doubt that a single-phase motor can be produced in which the commutation is as good if not better than in the direct-current motors that we are familiar with—those without commutating poles, in which the armature speed will not be more than fifteen per cent higher, with a larger air-gap than has been used here before, and with conditions for general operation that will make that motor much more nearly comparable to the direct-current motor than anything we have seen thus far, and this without the introduction of any extraneous resistance and with an increase in efficiency of several per cent. The weights of this motor will still be in the neighborhood of twenty-five per cent more than the direct-current motor of the same horse-power rated on the hourly basis. This does not mean by any means that the alternating-current motor takes precedence, but it means that the alternating-current motor has been improved, and improvements will continue to be made so that any conclusions which may be drawn with respect to the proper field of direct or alternating-current motors must not only take into account the conditions to be met, but also the improvements that will take place in the art, and with respect not only to alternating current, but direct current as well. He suggested that in considering the higher voltages with direct current, which unquestionably will be used (in fact there are a number of such installations being put in at the present time), the next step be to 1,200 volts. To reach this pressure by successive stages will induce an interminable complication.

Charles F. Scott, consulting engineer of the Westinghouse Electric and Manufacturing Company, said that in his comparison of the alternating and direct-current systems Mr. Sprague had overlooked certain valuable features of the alternating-current system, such as the voltage control, which are of great value. In the treatment of the subject Mr. Sprague has assumed the direct-current motor and its characteristics as the ideal, and that wherever the other motor had different characteristics, these characteristics were naturally and *per se* objectionable. Regarding the matter of braking, a system of braking by the single-phase motors, which has been worked out and fully tested, has shown that this motor lends itself admirably to braking.

N. W. Storer, of the Westinghouse Electric and Manufacturing Company, took issue with Mr. Sprague's catalogue of fifteen advantages of the direct-current system, disagreeing with all but one. He said the comparison of the two motors was not fair, and gave figures to show that the efficiencies of the two types are about the same. An alternating-current motor weighs about thirty-seven per cent more than an equivalent direct-current motor, but when mounted on the cars the difference is only ten per cent, and this greater weight is compensated for by the more efficient method of control of the alternating-current system.

G. R. Henderson expressed his approval of the conservative manner in which the application of electricity had been discussed in Mr. Sprague's paper. There are many railroads not at all suitable for electrification. He was glad to see that multiple-unit control is not considered feasible for freight operation, and that the great difference between this and suburban transportation is made clear.

William McClellan, of Westinghouse, Church, Kerr & Company, felt somewhat disappointed because the paper did not give definite information with regard to the 1,200-volt direct-current system. He also disagreed with the comparison made between the single-phase alternating-current and the direct-current systems. Motor capacity for a given weight is not so very important, as the electric train of the future will operate on the multiple-unit system. He dissented strongly with the statement that "Every large road is a problem which must be considered financially and technically on its own merits." The word "technically" should be left out. The statement should read "Every large road is a problem which must be considered financially on its own merits and technically in relation to the connections it may have to make in relation to the complete electrification which may come some day."

A. H. Armstrong, of the General Electric Company, said he had witnessed recently a test of an alternating-current motor, rated nominally at 125 horse-power, which operated at fifty per cent overload with perfectly black commutation, hardly a sign of a spark, though the machine carried only half its usual complement of brushes. It was a new development, and his previous ideas of the alternating-current motor had changed somewhat in consequence. But the direct-current motor is also open to certain developments. The commutating-pole motor has been developed and applied to the railway design, and the 1,200-volt motor is a success, and we can go higher if necessity calls for it. The alternating-current motor is also developing, and it is very hard to say just where it will stop. It is approaching very closely to the best performance of the direct-current motor as now in commercial operation. The alternating-current tests referred to were at twenty-five cycles, and there is no use in going down to fifteen cycles with all the incidental complications involved in so doing. He repeated the advice given by Mr. Wilgus that the installation of electricity on our steam roads calls for cool, calm, common-sense engineering, and we should not be too partisan advocates of any one system.

Dr. C. P. Steinmetz endorsed fully Mr. Sprague's statement that we are not ready yet to standardize one type of railway motor, one type of electrified steam railway. We will not be ready for some time, perhaps never. He agrees with Mr. Wilgus that each railway problem has to be considered on its own merits, and the proper method is to solve the problem chosen as far as possible on the lines of standards, on those lines which have been found satisfactory in every way. These should not be deviated from where it is not absolutely necessary. The great problem before us to-day is to replace by electric motors the steam locomotive in those cases where conditions of service have grown beyond the capacity of steam locomotives. These locomotives should be replaced by electric motors, either alternating or direct current, and the question whether the alternating motor or direct motor has the advantage is rather secondary. We should not overlook the main question by extending claims for the one or the other motor beyond the safe limits. We have at present a good alternating-current motor and we have a better direct-current motor, whatever argument may be brought against it. There is quite a class of service where alternating-current motors are necessary, such as a long railway with very infrequent service. In other cases, where there is a four-track or a six-track railway with such heavy traffic that the distance

between trains is limited only by the safe headway, the advantage is decidedly in favor of the direct-current motor, and there should be in such cases no excuse for using alternating-current motors. He does not share the objection to the rotary converter, and does not believe there is so great a gain in eliminating this link. It is an advantage in a system to eliminate some of the links in the chain; but we should eliminate the weakest link, and that is not the rotary converter, but the motor. The rotary converter is about the strongest link in the chain. Between these two extremes there is a very wide field, where either the alternating-current or the direct-current motor may be used, or, rather, where different engineers may be justified impartially in arriving at different conclusions. We should guard against adopting any one system which precludes us forever from going to the other, and not adopt any specialty that means going to an odd frequency. At present, after many years' work, we have succeeded in eliminating all frequencies except sixty and twenty-five cycles. At the present time all the heavy power of the country is transmitted at twenty-five cycles, which is the power frequency. As long as we remain at this frequency, it is not so formidable to use an alternating-current motor and then find the direct-current motors would be better, and we may use alternating-current locomotives in outlying branches of the road and run the main track on direct current, or the reverse. But as soon as we are forced to go to fifteen cycles the conditions become serious, because it would mean giving up all possibility of securing the benefit of the vast amount of power which is available in the country at twenty-five cycles. In regard to the 1,200-volt direct-current motor, his conclusion is that the commutation of this motor is so infinitely superior to the commutation of any alternating-current motor he had ever seen, until a week before, that there is no comparison. He repeated Mr. Armstrong's statement that he had recently seen alternating-current motors operating on heavy overloads, absolutely sparkless, which were just as good as the standard direct-current motor, or probably a little better.

Mr. Sprague, in view of the lateness of the hour, said he would reply to the discussion somewhat later in a written communication.

Exports of copper for the first four months of 1906 were 63,871 tons; for the same period in 1907, they were 56,918 tons. The imports were 32,420 tons for the first four months of 1906, and 43,300 tons for the same period in 1907.

A NEW LEADING-IN CONDUCTOR FOR ELECTRIC LAMPS.[1]

BY C. O. BASTIAN.

The difficulty of permanently maintaining a vacuum in an electric lamp is not satisfactorily overcome by the use of platinum for the leading-in conductors, as the costliness of this metal tempts the lamp maker to exercise excessive economy in the cross-section and length of the platinum used, and leaky seals may be the result.

FIGS. 1 AND 2.—LEADING-IN WIRE.

The form of seal usually known as the Siemens' seal—although the idea seems to have been originally suggested in one of James Swinburne's early patents—permits of economy in platinum within certain limits, but these limits are too often strained whenever the price of platinum rises, and the market is consequently flooded with short-life and inefficient lamps, to the disgust of the consumer and the discredit of the manufacturer.

In the Siemens' seal the platinum is completely embedded in glass, being merely a bridge between two heavier conductors, usually of copper and nickel. Now the cooling effect of these two heavy conductors, plus the cooling effect of the mass of surrounding glass, permits the use of platinum having a very small cross-sectional area, and theoretically—though not practically—the length of platinum wire may be cut down to a minimum.

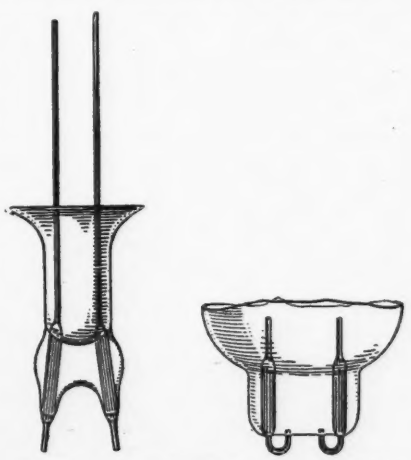


FIG. 3.—"SINE PLAT" LEADING-IN WIRE SEALED IN LAMP STEM.

Exactly how far it is practicable to reduce either or both of these dimensions has apparently not yet been ascertained by lamp manufacturers, but it is certain that the recent rapid and considerable rise in the price of platinum is calculated to lead many to attempt a reduction below the limits of safety, and the introduction of some cheap and effective substitute for platinum, which would not be subject to wide fluctuations in price, is now more than ever desirable, not only to the lamp manufacturer, but more especially to the lamp user, to whom lamps with an imperfect vacuum mean increased cost of renewal, perhaps twenty-five per cent increase in the bill for electricity, or poor light due to rapid blackening of the glass bulb.

Nickel and steel can be alloyed in such proportions as to have practically the same coefficient of expansion as glass, but leading-in wires of this alloy have not found favor in this country, although it is used in certain cheap foreign-made lamps. The surface of the wire becomes oxidized during the sealing-in process, and the thin layer of oxide is sufficiently porous to allow air to gradually percolate through, so that lamps made with this nickel steel alloy can not be stocked for any reasonable length of time without deterioration.

In selecting a suitable conductor for this purpose, the coefficient of expansion is by no means the only detail to bear in mind, and one is limited in one's choice by quite a number of essentialities, which may be set out as follows:

(*a*) The metal must be cheap.

(*b*) The melting point must be higher than that of glass.

(*c*) The quantity of gas occluded must be as small as possible.

(*d*) There must be absolutely no tendency to oxidize when heated in air to the temperature of molten glass.

(*e*) The coefficient of expansion must be as near that of glass as possible.

(*f*) The conductivity must be as high as possible.

The leading-in conductor now to be described has been chosen with due regard to all the above points, and it is the result of experiments extending over several years in the author's laboratory, the final solution of the problem being due to the ingenuity of George Calvert.

A copper wire of any desired gauge is selected, and of sufficient length to extend from the lamp cap to the filament. Near one end, and along fifteen millimetres of its length, this wire is rolled

[1] Paper read before the Glasgow section of the Institution of Electrical Engineers, of Great Britain, May 14.

flat to a thickness of 0.075 millimetre, as shown in Fig. 1.

Next a ten-millimetre length of soft enamel glass tube is slipped over the flattened portion of the conductor, and is melted on to it with a blow-pipe flame.

If this blow-pipe flame is properly applied under suitable conditions, the enamel glass can be melted on to the flat copper without the latter oxidizing in the slightest degree, and the enamel will then adhere to the clean polished metallic surface just as solder would adhere.

The enamel and copper appear to be actually joined together—amalgamated, as it were, one with the other—and not merely in juxtaposition.

It will be evident that this glass-coated metal can now be heated up to any desired temperature short of the melting point of the copper, without the latter becoming oxidized, because the glass coating will effectually prevent the access of oxygen to the surface of the metal underneath it. There is, therefore, nothing to prevent conductors thus prepared being sealed into a lamp stem, as shown in Fig. 3, and such seals have proved most perfect in practice, and have successfully withstood the very severe tests to which they have been subjected during the last eight months.

Out of the first batch of carbon filament lamps made with these leading-in wires—"Sineplat" wires, as they are termed by the makers—thirty were selected for a life test. They were arranged in two separate groups of fifteen each, and connected with a time switch, so that each group was alternately lit for ten minutes and out for ten minutes; long enough for the seals to get thoroughly hot and then thoroughly cold. This run was continued for 500 hours; then the time switch was disconnected and the lamps were given a continuous run for a further 1,000 hours. During this test none of the lamps failed through deterioration of the vacuum. There were two failures, but these were caused by the filaments coming adrift from the leading-in wires through loosening of the paste—purely mechanical faults, having nothing whatever to do with the question of vacuum.

The remaining twenty-eight lamps have been in use intermittently for, perhaps, an additional 500 hours, making an actual burning life of about 1,750 hours; but doubtless it is quite as important to note that the lamps were made over six months ago, because, as previously observed, lamps will often lose their vacuum while they are merely lying in stock.

An examination of these particular lamps shows that there has been surprisingly little blackening of the bulbs, and the author thinks that it is not generally appreciated how greatly this blackening is dependent on the degree of vacuum maintained.

The conclusions deduced from the test above described have been amply confirmed by several other independent trials, and it is now clear that the "Sineplat" seals are consistently good when made by hand, while preliminary tests with machine-made lamps promise equally satisfactory results.

On referring back to the list of conditions which are set out as the specification of a satisfactory leading-in wire, it is evident at a glance that while copper complies with this specification as regards most of the points, the condition as to coefficient of expansion is apparently not met, but the flattening of the wire increases the proportion of surface area to mass, and the strain on the glass due to the expansion of the copper is less at any point when the copper is in strip form than if the copper were a cylindrical wire of equal cross-sectional area.

As the proportion of surface area to mass of copper is increased, so is the cracking strain of the copper upon the glass reduced, and if the copper is flattened below the point of critical thickness, then no cracking will result. For the lead glass usually employed by lamp manufacturers, this critical thickness has been determined by experiment at about 0.1 millimetre, and with this gauge of copper about fifty per cent of the seals will crack, but below this gauge—0.075 millimetre—no cracking whatever takes place, even though the projecting copper wire be raised to a red heat close up to the glass.

The cheapness of the metal permits of a much larger cross-section being used than would be possible with platinum, and added to this there is the higher conductivity of the copper to assist in keeping the seal cool.

The applicability of the "Sineplat" seal to X-ray and mercury vapor apparatus may be here suggested, though reports of practical results are not yet available. It can, of course, be used in any of the new metallic filament lamps, in which the relationship between the blackening and degree of vacuum seems to be quite as close as in the case of the carbon filament.

The introduction of a substitute for platinum is not likely to result in any reduction in the price of lamps to the public, as any economy that the manufacturer may effect as a result of this should be set off by improving the quality of the lamp in some other respect.

The author can foresee no valid objection to this form of seal, unless it emanates from the scrap-metal merchant who loses a proportion of his trade when platinum-made lamps go by the board.

A NEW TYPE OF GRAPHIC RECORDING METERS.

H. W. YOUNG.

As the necessity for obtaining accurate records becomes more apparent to central station managers, means of obtaining these records automatically are demanded. Indicating instruments were first used and the station attendants were required to record the readings of the meters on tabulated sheets at frequent intervals and from these records curves could be drawn showing graphically the meter readings and their variations. But this method, aside from the extra attention required from the switchboard attendants, is more or less inaccurate, as the readings are rarely taken at less than fifteen-minute intervals and even if arranged to be taken at shorter intervals, there are times when the attendants may find it inconvenient to take the readings and are quite likely to get into the habit of estimating the readings and filling in the blanks. In addition, after the records have been tabulated there is much clerical work involved in making corrections for the inaccuracies of the different instruments and in plotting the curves for each day.

Use of Integrating Meters—Integrating meters give accurate records of the total energy consumption, but do not give any idea of the load variation, and even with them readings have to be taken at regular intervals. Graphic meters have been in use for some time, principally for use as voltmeters and ammeters, but these have been either of the type that makes a record on a circular chart which has to be replaced each day or of the type which makes a record on a sheet or roll of paper with curved co-ordinates.

Ordinary Forms—The disadvantages of the graphic meters heretofore designed have been:

1. The daily attention required for winding the clock, changing the paper or filling the pen.

2. An appreciable difference in the readings occasioned by the friction of the pen.

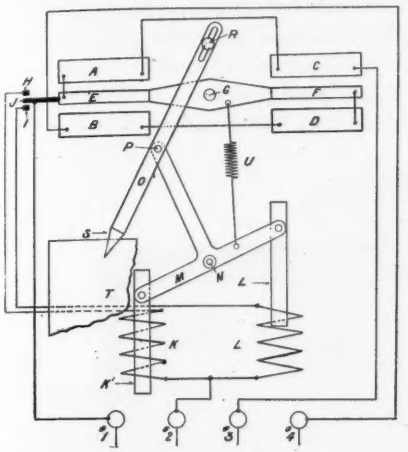
3. The increased power necessary to reduce the effect of friction. This power in the alternating-current meters is drawn from the series or voltage transformers, and thus causes inaccuracy or necessitates larger or more expensive transformers; in both alternating-current and direct-current meters the operating coils had to be designed to give high torque rather than high accuracy.

4. Absence of means for varying the

sensitiveness and speed of the pen motion in following variations of the circuit.

5. Difficulty in reading and interpolating the records, especially when circular charts of slow speed and narrow conjested scales are employed.

New Type of Graphic Meter—The new



ARRANGEMENT OF PARTS, GRAPHIC RECORDING METER.

type of graphic recording meters illustrated and described herein makes a record on a continuous roll of paper ruled with rectangular co-ordinates. The motion of the pen across the paper is proportional to the quantity to be measured and the speed of the cross-section paper is controlled by an electrically self-winding clock. It is possible to integrate any part of the record by the use of a planimeter or other means.

The meters are made in the following forms: voltmeters, ammeters, single-phase and polyphase wattmeters, power-factor meters and frequency meters.

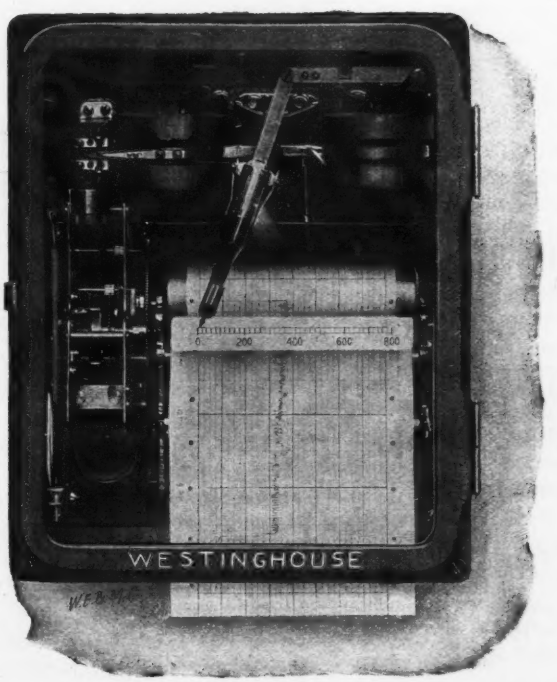
Principle of Operation—All the meters are of the "relay type" employing a suitable measuring element in conjunction with a pair of electromagnets actuating the recording pen. There are in each meter three general elements: (1) the meter; (2) the pen-actuating electromagnets; (3) the driving clock.

Measuring Elements—The measuring elements of voltmeters, alternating-current ammeters and wattmeters are of the "Kelvin" type employing a system of fixed and movable coils arranged in a similar manner to those of the "Kelvin Standard Laboratory Balances." These meters, up to the limits of their capacities, can be used upon either direct or alternating-current circuits. Frequency and power-factor meters are of the ratio type operating upon the "induction principle."

Direct-Current Ammeters—Direct-current ammeters are of the "permanent magnet moving coil" type employing a set of two movable coils pivoted within the influence of two permanent magnets and astatically arranged so as to be free from the influence of stray magnetic fields. Each ammeter operates from an external shunt similar to those used with shunted type indicating ammeters.

Construction—The construction of a voltmeter is diagrammatically shown in Fig. 1, in which the various elements of the meter are designated as follows:

A-B-C-D = Fixed coils.
E-F = Movable coils mounted on supporting structure pivoted at G.
G = Pivoted support of E-F.
H = Upper adjustable relay contact.
I = Lower adjustable relay contact.
J = Movable relay contact attached to movable element E-F.
K = Pen actuating electromagnet (left hand).
K′ = Iron core of K.
L = Pen actuating electromagnet (right hand).
L′ = Iron core of L.
M = Arm supporting iron cores pivoted at N and connecting O by pin bearing P.
O = Pen arm connected to M by pin bearing P and provided with guide slot at upper end which bears on stationary guide pin R.
S = Recording pen arranged to pass across a suitable moving record paper T.
U = Helical spring connecting movable coil system and movable pivoted supporting arm M.



GRAPHIC RECORDING WATTMETER WITH INDICATING DISC.

Connections—The coils A-B-C-D-E-F are all connected in series and their terminals connected to binding posts Nos. 3 and 4.

The electromagnets K and L are connected as shown with their junction point brought out to binding post No. 2. Connection from coil K is made to the upper relay contact H and connection from coil L to the lower relay contact I. The relay contact J of the removable system is connected to binding post No. 1.

To binding posts No. 1 and No. 2 are brought leads from a direct-current or other auxiliary circuit of proper voltage and to binding posts No. 2 and No. 3 are brought leads from a circuit the potential of which is to be recorded. An external resistance is employed in the measuring circuit of all capacities and in the electromagnet control circuit for potentials of 500 volts direct-current.

Action of Meters—The system of fixed and measuring coils is so arranged that when current flows through them the left hand coil E is repelled by A and attracted by B, the right hand coil F being repelled by D and attracted by C. Assuming the recording pen to be at zero position on the chart and connection made to relay and measuring circuits through binding posts Nos. 1, 2, 3 and 4, it will be seen that the movable system will take up a position which will force contact J against contact I. A circuit will thus be completed through the right hand solenoid L and the electromagnetic attraction will cause the core L′ to move downward, which movement will turn M about its axis and through its connection with O cause the pen to move across the chart toward full scale position.

This movement of M places tension on the spring U and continues increasing this tension until the core has traveled a sufficient distance to place such a tension on U that it balances the torque of the movable measuring system E-F and draws the contact J away from I.

The entire moving system, including solenoids, pen arm and measuring coils, remains in the position last assumed when the circuit was broken and the pen continues to draw a line which represents the voltage being maintained on the circuit.

Comparison with Siemens Dynamom-

eter: It will be noted that the spring U is now under tension and the position of the contact J between contacts H and I represents a balance or state of equilibrium between the actuating and restraining forces. This can readily be compared to the action of a "Siemens dynamometer" in which the knurled thumb nut has been turned until the torsion of the control spring has drawn the pointer attached to the movable coils back to zero and the pointer operated by the knurled thumb nut will indicate the circuit voltage. The zero reading pointer of the dynamometer can thus be likened to the movable contact J of the graphic meter and the manually operated pointer of the dynamometer may be likened to the solenoid-operated recording pen of the graphic meter. It will be seen, therefore, that the manual operation of the dynamometer's indicating pointer is replaced by electrical operation of the graphic meter recording pointer.

Action on Varying Voltage—If the voltage of the metered circuit rises, the movable contact is again deflected downward until it makes contact with the lower fixed contact and the right hand solenoid again causes the recording pen to move across the chart until the increased tension of the spring balances the increased torque of the measuring element, drawing the movable contact J away from I and again opens the solenoid circuit. The recording system again remains stationary until the voltage of supply circuit changes.

If the voltage decreases the contact J rises and making contact with H, energizes the left hand solenoid K, which drawing down its core causes the pen to move down the scale toward zero, and as this movement continues the arm M moves up sufficiently to relieve the tension on U and restore balance between the actuating forces of the measuring system and spring, when the contact J will leave H and open the control circuit through K.

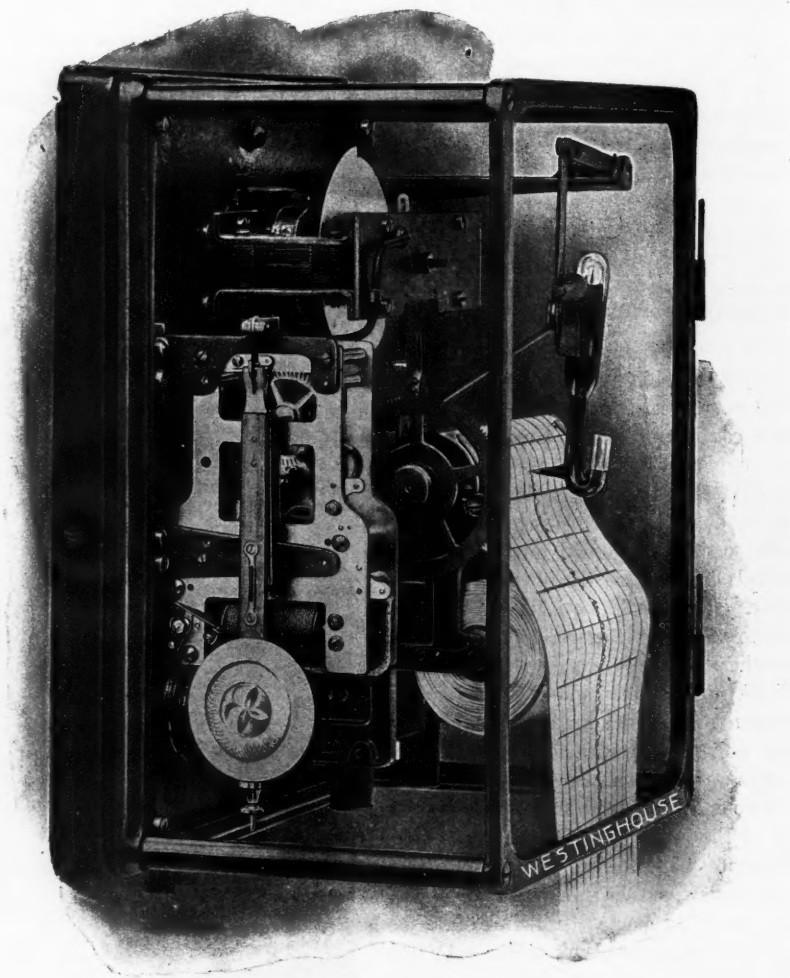
It will thus be seen that as the voltage varies the contact J moves up and down, completing the circuit through one or the other control solenoids, causing the recording pen to move across the chart and thus gives a graphic record of the voltage variations.

Straight Line Pen Movement—In order to secure scales having rectangular co-ordinates it is necessary that the pen move across the chart in a straight line. This straight line motion is obtained by the mechanical arrangement of the solenoid arm M and pen arm O. As M by the action of solenoid L rotates toward the right and about its pivoted support N, the pen arm O sliding upward on guide pin R and rotating on pin P imparts to the recording pen S a straight line motion. As M rotates toward the left the recording pen S travels in a reverse direction. This parallel motion arrangement is extremely simple, effective and a well-known motion in mechanics.

Contacts—The contacts H, I and J are made of specially alloyed dissimilar metals designed to break the circuits with minimum burning or arcing. To eliminate injurious sparking the contacts with direct-current and twenty-five-cycle control solenoids are shunted by a high resistance and with sixty-cycle control are shunted by a condenser with series resistance.

Pen-Actuating Electromagnets — This element of the meter, with slight modifications, is common to all forms. It consists of a pair of powerful electromagnets differentially actuating a pair of pivotally mounted iron cores. The movement of these cores drives the recording pen through a set of levers so arranged as to impart a straight line motion to it.

The circuit of the electromagnets is independent of that of the measuring element. The moving system of the measuring element, however, operates a differential set of contacts which alternately energize one or the other of the electromagnets, depending upon the position of the measuring element movement. These electromagnets are wound for operation from direct-current circuits having nominal voltages of either 110, 220 or 550, or for 100 volts alternating current.



Graphic Recording Frequency Meter.

Dash Pots—Attached to the cores of the pen-actuating electromagnets of all meters are pistons operating in oil dash pots. Their function is to dampen the movement of the cores, relieving them of their excess momentum so that they will not overshoot and hunt. The magnitude of this control may be varied by changing an adjustable opening in the piston discs.

Attached to the moving elements is a piston moving in a small oil dash pot. Its function is to dampen the movement of the moving system by absorbing its ex-

cess momentum and thus prevent it from overshooting, hunting and vibrating against the contacts. The magnitude of this action is variable only by changing the oil density, a heavy oil giving greater dampening and *vice versa*.

Sensibility—By varying the distance between the contacts H and I the sensibility may be controlled. When the contacts are close together, the slightest variation in the load will be recorded, giving, in some cases, a very irregular line. By increasing the space between the contacts, the meter will not record such small changes and the curve will be more regular, but large variations will be recorded with equal accuracy.

The quickness of action is controlled by the adjustment of the main dash-pot pistons. By removing the cylinders and increasing the width of the adjustable slot in the pistons, through which the oil circulates, the pen action may be quickened. For extreme slowness, on badly fluctuating loads, a heavier oil may be used, and where a quick response to change in load is desired a light grade of oil will give the desired result.

Clock—The clock is a standard high-grade time piece of the electrically wound pendulum type. Its function is to drive the record paper under the recording pen at a uniform predetermined rate, synchronous with the time markings on the record paper.

Its electrically winding mechanism is operated from the same circuit as the pen-actuating electromagnets. The clock winds automatically every hour, the spring being of such a size that but a few of its outer convolutions uncoil during this period and thus the clock mechanism is under a strong uniform force which together with the heavy pendulum action gives a powerful driving force insuring a positive feed to the record paper.

The driving motion of the clock is transmitted to the paper roll through a gear and pinion. The standard driving speed is two inches per hour, but driving speeds of four inches and eight inches per hour may easily be obtained, the change being effected by the use of suitable gears and pinions having different ratios of teeth.

Record Paper—A specially calendered and ruled grade of paper is used and furnished in rolls 244 feet in length, being sufficient for two months' use at a two-inch-per-hour speed or a proportionately shorter time at four or eight inches per hour. The rolls are six and one-quarter inches wide and are perforated at each outer edge by a line of holes which engaging on projecting pins on the surface of the driving cylinder insure a positively aligned feed under the recording pen.

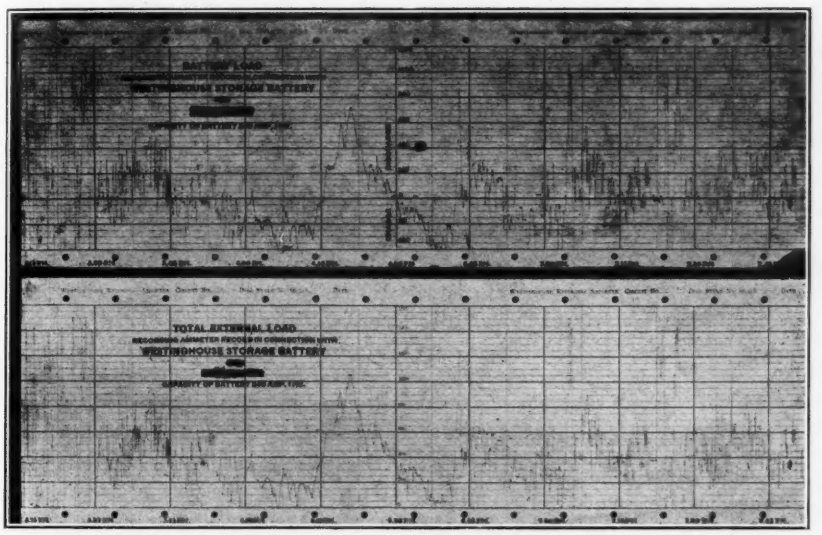


Chart Used with Graphic Recording Wattmeter.

Graduation of Paper—The paper is ruled longitudinally with a set of parallel lines which represent the meter calibration, this ruling varying with the different types and capacities. At right angles to the calibration lines are a set of parallel lines representing hours, varying in distance from each other with the particular rate of speed for which the paper is ruled. The two-inch-per-hour paper has its hour marks two inches apart, four-inch-per-hour, four inches apart, and eight-inch-per-hour, eight inches apart.

The paper is of such thin, tough texture that it can readily be used for reproducing the pen records by blue-printing or other similar processes. The scales are five inches in length and the distribution of wattmeter, frequency meters and direct-current ammeters is uniform. Alternating-current ammeters, power-factor meters and voltmeters are not entirely uniform, although a very open distribution at the working part of scale is obtained.

The rectangle co-ordinates permit of a record or chart much clearer and more easily interpolated than can possibly be obtained with circular charts or with those having curved rather than straight-line calibration. The wattmeter records readily lend themselves to totalizing by means of planimeters.

Recording Pen—The recording pen is constructed of glass formed so as to provide an ink reservoir of such capacity that one filling suffices for several months' use. The pen point is drawn to a capillary tube of heavy wall and small bore giving maximum strength with minimum width of line.

Filling of the pen is accomplished by inverting it and inserting the special filler accompanying pen in opening in tube immediately behind the point and then forcing in ink until the large reservoir is full, when the pen may be righted in position and the tube recorked. Any good fountain pen fluid may be used and special inks such as are frequently required with many forms of meters are unnecessary.

Alternating-Current Ammeters, Single-Phase Wattmeters, Polyphase Wattmeters—All those meters operate upon the same principle as the voltmeters, differing only on the windings of the measuring circuits.

Direct-Current Ammeters—These meters operate upon the same general principles as the alternating-current meters, but employ a measuring system having fixed permanent magnets instead of fixed coils. The movable coils are similar in appearance to those of the voltmeters, but are wound of heavier wire and of fewer turns.

The moving coils are connected in series with each other and through a small calibrating resistance to two right hand binding posts of the meter from which connection is made to the terminals of an ammeter shunt in series with the load. This shunt is the same as used with indicating ammeters and the moving coils operate upon the same drop—approximately fifty millivolts.

When desired, graphic ammeters can be operated from the shunts of other ammeters already installed.

The shunted type of direct-current graphic ammeter has a very decided advantage over the series type of meters—especially in the larger capacities, as frequently the extra buses and leads required to connect a series meter cost more than the meter itself.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A Magnetic Detector for Wear in Wire Ropes.

At a recent meeting of the Transvaal Institute of Mechanical Engineers an ingenious device for detecting variations in the cross-sectional area of wear in wire ropes was described by C. McMann. A brief description of this device is given here. Its action depends upon the variation in the reluctance of a magnetic circuit due to a change in the length of an air-gap caused by variations in the diameter of the rope being examined. A reactive coil wound on a bobbin is threaded over the rope, and two U-shaped iron cores are placed without this, so that the wire rope itself forms the central core. This coil is connected in circuit with an ammeter, and the coil of a small transformer, the primary of which is connected to a supply circuit. The instrument then indicates the current flowing through the coil, and this current will be varied by changes in the reluctance of the circuit caused by any variations in the length of the air-gap. To examine the rope it is caused to pass slowly through the coil, while a current is being sent through it from the transformer. The reading of the ammeter then follows the changes in the length of the air-gap, and any sudden or unusual reading is an indication of some inequality needing examination.—*Abstracted from the Iron Trade Review (Cleveland), May 9.*

A Two-Gauge Tramway Truck.

The fact that different cities in England have adopted different gauges for their street railway systems frequently makes it impossible for the two systems of neighboring towns to connect for the cars to be routed through. Such a condition exists at the two towns of Bradford and Leeds, the street railway systems of which connect. To get over the objection of transfering passengers from one car to the other, or, in other words, to make possible the running of a single car on the systems of both towns, C. J. Spencer and J. W. Dawson have designed a truck in which the gauge is adjustable, enabling a single car to run on both sets of tracks. Two types of truck have been designed. On one of these the wheels and gears are mounted on sleeves which may slip along the axle. They are held in the extreme position by means of locking blocks. As the car approaches the junction of the two tracks the locking blocks are raised, and as it proceeds along a tapered section of the track, the wheels automatically change from one gauge to the other. The blocks are then dropped, locking the wheels in the new position. In the other design the axle is divided at the centre, and is itself adjustable axially. The running wheels and the gear are mounted rigidly on those two short axles, which are supported by means of boxes at the sides of the truck, and two additional boxes carried on brackets near the centre. In both of these designs each motor is fitted with two pinions long enough to allow for the shifting of the gears. The change in gauge is from four feet to four feet eight and one-half inches. A truck constructed according to the first design has been tried recently, and is said to have given satisfaction.—*Abstracted from the Tramway and Railway World (London), May 2.*

Unstable Shunt Motors.

Two sixty-horse-power, 400-volt, six-pole shunt motors, coupled direct to one shaft of a machine, and connected electrically in parallel, were found to be unstable when operated at high speeds by means of a weakened field excitation. One explanation offered of this attributes the difficulty to the use of laminated poles. Although this construction reduces the eddy current loss at the pole face, and permits of relatively wide armature slots, besides offering constructional advantages, it does not conduce to the good running of variable-speed motors, unless additional precautions are observed. The laminated structure of the pole offers a relatively small resistance to a change in the field flux, and although it is usual to cut a central slot through a portion of the pole for commutation purposes, there is no advantage to be obtained from this in the stability of the machine. Such machines generally show a tendency to be less stable than those in which the pole face is continuous. If a motor with an ordinary laminated pole be run loaded, and the speed increased by weakening the field, a point will be reached where the operation becomes unstable, the speed continually surging between maximum and minimum values. The speed at which this begins depends upon the ratio of the ampere-turns for gap and teeth to the ampere-turns per pole. It is also affected by the position of the brushes. By properly placing the brushes, the demagnetizing effect of the armature reaction may be reduced or overcome; but this does not prevent the surging of the field flux from pole tip to pole tip, nor does a central slot in such stampings correct this, for it is generally found that when this slot extends to the pole face the tendency for the flux to surge is even greater. This surging may be controlled in several ways. In designing a new machine the pole face may be made of wrought iron of highest conductivity. For an old design a short-circuited spool of copper may be placed around the pole. When it is not possible to rewind the pole spools, a bare stranded copper wire may be wrapped around the pole shoe and sweated together, thus forming a short-circuited ring; or a copper grid of the kind used to stop surging in rotary converters may be inserted between the tips of adjacent poles. Compounding the field coils would probably make matters worse, as the trouble is apparently due to the flux oscillation, and not to weakening of the field.—*Abstracted from the Electrical Engineer (London), May 3.*

An Electrical Method of Depolarizing Primary Batteries.

There are two methods in general use for furnishing the igniting spark for gas engines. One employs batteries, and the other a magneto. In the former plan the batteries are exhausted quickly unless the equipment is comparatively large. In the latter case the magneto is in service but momentarily during each explosion, and therefore is considerably larger than would be necessary if it could work continuously, storing up energy to be used for supplying the momentary discharge. To overcome these defects of the two systems, F. W. Springer has designed a combined system, which has the advantage of enabling a spark to be obtained when the

engine is not running, and at the same time, by charging the primary batteries from a small magneto, prevents polarization and increases the life of the batteries. The plan adopted is simple. It consists merely in connecting the batteries in parallel with a small dynamo. During the period between sparks the dynamo, which is driven by the engine, is passing a current through the primary batteries, thus charging them; while at the moment at which a spark passes through the igniter, the current is mainly drawn from the batteries. It was found that when used in this way the intermission between charge and discharge of the batteries was so slight that they practically behaved as storage batteries, and there was no resultant chemical action. Oscillograms are given for the performance of the various parts of the system. The dynamo delivers a direct current varying somewhat in amount. The battery is charging for about two-thirds of a cycle, and is discharging during the remainder of the time. The battery voltage varies considerably, being nearly constant at seven volts during charge, and falling to about one volt at the end of a discharge.—*Abstracted from the Year Book of the Engineer's Society of the University of Minnesota (Minneapolis), April.*

Induction-Motor Planer Drive With and Without Flywheel.

The ordinary type of metal planing machine has a peculiarity among machine tools of requiring an excess of energy at the instant of reversal. Although this demand is but momentary, it may amount to as much as five or six times that required by the machine when cutting. The condition is made necessary by the use of reverse belts designed to give a reciprocating motion to the planer table by shifting from tight to loose pulleys. The mechanism shifts the belt quickly into position, a requirement necessary to provide sharp and precise reversing with a minimum amount of drifting of the planer table. To learn something of the conditions which obtain when an induction motor is used to furnish the power to drive a planer, a series of tests was made by Howard P. Fairfield with a ten-horse-power motor used to drive a thirty-six-inch by ten-foot planer. The object was to determine what would be the effect upon the power consumed by changing the length of stroke and by the use of a flywheel upon the planer drive. It was desired to keep the weight and diameter of the flywheel as small as possible, and it was therefore mounted upon the shaft having the highest rotative speed. The wheel was designed to have sufficient inertia to store and restore energy for taking care of the shock of reversal, without material change in the speed of the motor. The planer was worked at from one-half to full stroke, a condition which would most probably be met in practice. The problem was resolved into that of a long stroke with a definite number of reversals to surface a given area, and that of one-half the full length of stroke and double the number of reversals to surface the same area. The following are the results obtained: With a short stroke of five feet, without the flywheel, the power consumed was 1.848 kilowatt-hours to surface 2,160 square inches. For the long stroke, without the flywheel, 1.628 kilowatt-hours were required to do the same work. Adding the flywheel, the same area was surfaced with the short stroke with an expenditure of 1.302 kilowatt-hours. The corresponding figure for the long stroke was 1.240 kilowatt-hours. These show that the per cent of gain of the long stroke over the short stroke, without the flywheel, was twelve. For the short stroke, with the flywheel, over the short stroke without, the gain was 29.5 per cent. The long stroke showed a gain when the flywheel was used, of 32.9 per cent. The following are the costs of power per hour for the various conditions: 9.24 cents for the short stroke without the flywheel, and 8.33 cents for the long stroke. The short stroke with the flywheel costs per hour 6.51 cents; with the long stroke, similarly operated, 6.2 cents. The price of energy is taken at five cents per kilowatt-hour.—*Abstracted from the Journal of the Worcester Polytechnic Institute (Worcester), May.*

Wind Power for the Generation of Electricity.

In the concluding section of this article, the first part of which was noted in the issue of the ELECTRICAL REVIEW for May 25, the author, W. O. Horsnaill, gives estimates of the cost of generating electricity by means of wind-mills. The first cost of a disc type of mill to deliver five brake-horse-power to the dynamo, the wheel being twenty-four feet in diameter, is given as $2,510. This includes the cost of the wheel erected, foundations, dynamo, battery, switchboard and house. The main costs are that of the wheel, $1,100, and of the battery, $750. The annual cost of operating is given at $417, which includes attendance, battery renewals, repairs and interest on the cost. This estimate allows for 2,000 hours of lighting during the year, with an average current of twenty-five amperes at 100 volts. It brings the cost of power to eight cents per kilowatt-hour. Substituting a four-sailed mill for the disc mill, the cost of the installation is reduced to $2,110, and the cost of operation to $357. The comparative cost for installing and operating an oil-engine installation to do the same amount of work is given as $2,000 for the first cost, and $537 as the cost of operation. The problem is then compared with that of lighting a train by means of a dynamo driven from the axle, the two being generally considered the same. It is shown, however, that by adding to the simple wind-mill equipment considered above the automatic regulators necessary for a train-lighting system, the size of the battery required will not be reduced, although it will add to the expense of installation and of maintenance. Such automatic control is not thought necessary for the wind-mill drive, because it is generally operated during the day, when it can be watched by the attendants. Brief descriptions are then given of two notable wind-mill installations, both in England. The first consists of a thirty-five-foot disc wind-mill coupled to a thirty-five-ampere shunt dynamo capable of giving out a voltage of 150 for charging the battery. The wheel is mounted on a fifty-foot tower. The dynamo is a plain shunt machine running at 750 revolutions a minute. The switchboard is of the usual type with cut-in and cut-out switches. The original number of sixteen-candle-power lamps installed was 200. There are also three motors, aggregating five horse-power, attached to the system. The original battery was rated at 300 ampere-hours. This battery is considered much too small for the work. The dynamo also should have had nearly double the output of the one employed, and a thirty-foot wheel might have been employed. In spite of this lack of proportion the system was kept going on one occasion for six weeks without any trouble whatever. The other plant consists of a thirty-foot wheel coupled to a specially-wound dynamo, charging a battery with a large output. There are 109 lamps connected to the system, most of them being of sixteen candle-power. The rating of the battery is not given, but is said to be sufficient to carry the plant over any calm periods which occur. The whole installation is in charge of a gardener, requiring about four hours a week. —*Abstracted from the Electrician (London), May* 10.

Methods of Getting New Business

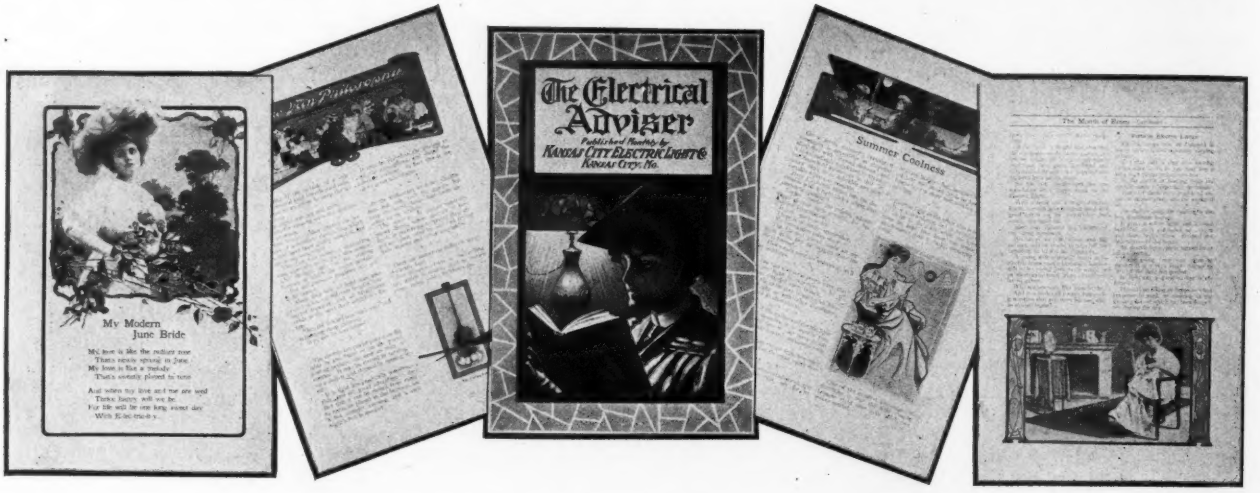
A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

What has Been Done and is Being Done in the Way of Obtaining New Business by the Kansas City Electric Light Company—The Men Who Are Doing It, and How They are Doing It.

Kansas City, Mo., with its population of 250,000, is one of the fast growing cities of America. Called the Chicago of the Southwest, its hustle and bustle gives the impression that American enterprise is everywhere, that advantage is being taken of every money-making opportunity.



The cover and four of the inside pages of the handsome bulletin of the Kansas City Electric Light Company. This reproduction does not begin to do justice to this valuable piece of advertising, giving only a fair idea of its general make-up.

Mr. R. E. Richardson, general manager of the Kansas City Electric Light Company, who has accomplished wonders in the building up of the business of that company.

In June, 1900, the Kansas City Electric Light Company, then a small industry, stood practically stationary in so far as growth was concerned. Change of ownership brought to the management of the properties Robert E. Richardson, then and now one of the brightest minds of the electrical world. The record of the company, under the guiding hand of Mr. Richardson for seven years past, constitutes a remarkable page in electrical development in this country.

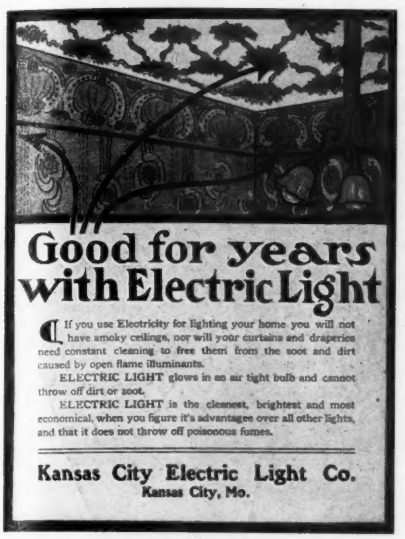
In June, 1900, the books showed that the company had 600 customers and 500 meters installed. In March of this year, exactly six years and eight months later, the books showed that the company had over 9,000 customers and 9,500 meters installed, an increase in customers of 8,400, or fifteen times as many customers as they had in June, 1900, and nineteen times as many meters. In June, 1900, the company had 21,599 sixteen-candle-power equivalent connected load, and 740 horse-power. March, 1907, showed that the company had 313,233 sixteen-candle-power equivalent connected load and 10,543 horse-power. This is a most remarkable showing, and proves that the Kansas City Electric Light Company, under the management of Mr. Richardson, has grown faster than Kansas City itself.

Personal contact with the man at the helm of this business reveals why this wonderful growth has been possible. He possesses the executive ability and technical knowledge so necessary to success, yet combines with it a geniality that has made him extremely popular with both employé and customer. The soul of good nature, Mr. Richardson permeates his business with the tincture of kindness. He may be styled a typical captain of industry and possesses the acute faculty of being able to put the right man in the right place. It is said of his organization that it operates with as little friction as any corporation on earth. Every man knows his work and bends to it the unceasing energy imbued by the manager. Pride is taken by all in developing rapid growth, and when the detailed reports show a healthy

Mr. R. S. Bogie, the hustling director of the new-business department of the Kansas City Electric Light Company.

increase there is happiness exhibited from manager to office boy.

Realizing after four years of strenuous work that much could be accomplished, a "New-Business Department" was installed in June, 1904, and Rector S. Bogie was


Good for years with Electric Light
If you use Electricity for lighting your home you will not have smoky ceilings, nor will your curtains and draperies need constant cleaning to free them from the soot and dirt caused by open flame illuminants.
ELECTRIC LIGHT glows in an air tight bulb and cannot throw off dirt or soot.
ELECTRIC LIGHT is the cleanest, brightest and most economical, when you figure it's advantages over all other lights, and that it does not throw off poisonous fumes.
Kansas City Electric Light Co.
Kansas City, Mo.

One of the mailing cards sent out to a list of unwired residences. The campaign of which this formed a unit was the means of wiring up a large number of such houses.

appointed director of this department. It was a good selection, and Mr. Richardson again demonstrated his ability to select the right man for the place.

Mr. Bogie is an expert systematizer. He is also thoroughly well acquainted with printing and typography, which enables him to see that the business literature, ad-

A well-designed folder which was sent out, with good results, by the Kansas City Electric Light Company to prospective users of electric power.

vertising matter, etc., is most effective and artistic. Possessing a personality that makes friends for him everywhere, a fluent conversationalist, and well educated, he makes an ideal director for a contract department. Probably the most remarkable of Mr. Bogie's qualities is his tact. One who knows the intricate difficulties that he has had to contend with since the organization of this new-business department can appreciate the labor required to keep his customers, as well as the men who work under him, satisfied.

When Mr. Bogie took charge on June 1, 1904, the connected load of the company amounted to 128,365 sixteen-candle-power equivalent, and 3,644 horse-power. This department wrote 3,543 contracts between June, 1904, and June, 1905, 5,321 contracts between June, 1905, and June, 1906, and 5,578 contracts between June, 1906, and March, 1907.

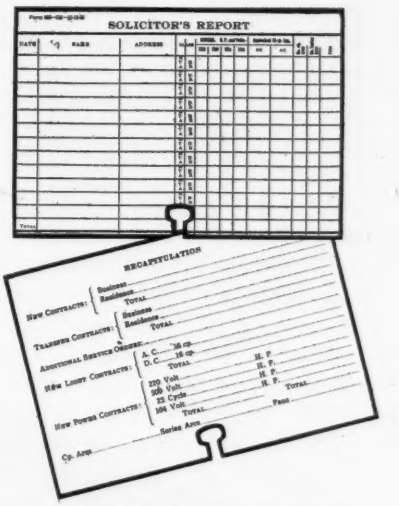
The details of getting these contracts and increasing the business should be very interesting to every man connected with a central station plant. The main reason why the company has had such a remarkable success is no doubt due, in the first place, to good generalship, but the accomplishment of the results shown on the books was due entirely to hustle, system, and the running of their business on the broadest and most modern lines.

The phenomenal growth of the company in recent years has been a source of much comment throughout electrical America, and the endeavor will be made to show why this growth has been possible.

The officers of the company are Bernard Corrigan, president; W. E. Kirkpatrick, secretary-treasurer, and R. E. Richardson, general manager.

When Mr. Bogie took charge as director of the New-Business-Getting Department, he immediately surrounded himself with good men and adopted practical advertising matter to back up his solicitors. He inaugurated a plan whereby the resident lighting is handled by five solicitors, each man having his own territory, the results in which he is held strictly responsible for.

The solicitor begins his work by visiting the stone mason who puts in the foundation of any new building in his territory. He learns the name of the builder or owner and visits him to find out if the building is to be wired. Receiving an affirmative answer, he investigates and finds when the building will be completed, filling all data in his own card index box (illustration of card for this purpose shown in this article), and brings it forth at the proper date to secure contracts for lighting. If he receives a negative answer, he begins at once his campaign to have the wiring put in. He persists until results are reached, or failing he reports to contract agent, and another man is sent on the work. The campaign never ceases until results are reached, or the building opens with other illumination, and even then frequent visits are made in the hope of finally securing the business. This line of cam-

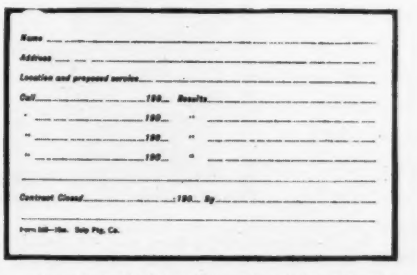


A handy and comprehensive card used in keeping track of solicitors and prospective business.

paign has been carried out carefully over a period of three years, and has made it the exception rather than the rule, for a house not to be wired.

Careful attention is also paid to getting old houses wired, and right here was where good, systematic direct-by-mail advertising was brought into use with the following results:

In May, 1906, the company sent a man over its pole lines to compile a list of occupants of houses not wired. Upon completion of this work, he had compiled a list of one thousand homes which were unwired. This list of one thousand was turned over to an advertising firm, and a contract was placed for one thousand pieces



A card supplied to solicitors for their personal use in keeping track of prospects.

of resident advertising literature to be sent out once every month for a period of one year. The advertising went continuously each month to this list from June until December (seven months) without any form of solicitation being used by the

company. In December the company detached two of its best residence solicitors from regular territory and started them over the list of one thousand names, for the purpose of determining what results had been reached in the way of wiring these houses.

On April 27 the solicitors turned in their reports, which showed that 243 of the 1,000 houses had been wired, and that during the period of their work, from December to April, 653 of the residents on the list had expressed a request for wiremen to call and give them figures.

Of the 243 houses found already wired, eighty-two voluntarily stated that the wiring of their homes resulted from the advertising literature.

The company stated, however, that many more than this number of those already wired was the direct result of the advertising, and that only the innate modesty of the people solicited prevented them from making a statement to the effect.

To work in harmony with contractors and to help things along, the names of all persons desiring wiring are posted in the office at the contract desk of the company, and any contractor is at liberty to copy names and addresses and go after the job of wiring the house.

Fixture firms are given the same privileges as the contractor in this respect. The company does no interior wiring of any description, and handles no supplies other than lamps and electrical heating devices.

Mr. Bogie has put the business lighting of Kansas City in the hands of two experienced solicitors, men who know how to illuminate a store properly, tastefully and economically. They talk sign and window lighting, interior decoration and general illumination with equal facility. These men obtain big business by constantly assisting merchants and keeping in close touch with all business places. A selected list of business places is sent monthly attractive advertising matter illustrating the advantages of electricity for interior and exterior lighting, and it is found that this matter assists the company greatly in closing contracts.

Electric signs are solicited for actively and any kind of sign is given on any kind of terms. Merchants can buy them outright or rent them. They can put them on their own meter or get a flat rate for so many hours. They can have their signs turned on and off and maintained. This work is handled by a company operating independently of the electric light com-

A well-gotten-up, well-printed and well-written folder sent out to prospective power users.

Your at Home Day
With Electricity in the Home
Kansas City Electric Light Co.
CONTRACT DEPARTMENT
1300 Grand Avenue
Enjoy the Ocean-like Breezes of an Electric Fan

One of the very attractive residence folders of the Kansas City Electric Light Company, showing same ready for mailing and also opened out.

pany, the lighting company selling current for the signs on contract.

Mr. Bogie has put the power work in charge of three solicitors, experienced men who furnish plans and estimates to prospective consumers for the economical use of electric current. Their field is largely with the manufacturers, large and small, and the results of their work, assisted by advertising which is sent out monthly to a list of prospective power users, has made Kansas City an electrically driven town.

In this work the company that handles the advertising of the Kansas City Electric Light Company is furnished the list of prospective power users, the same as with unwired houses, and sees to it that these prospects are mailed monthly attractive advertising matter, illustrating by word and picture the value of electric power.

The solicitors of the company therefore, find that their pathway for more business is less thorny, as a result of the advertising wedge. In the work of changing hydraulic elevators to direct-connected or motor-driven hydraulic, the power solicitors furnish estimates and figures to owners of buildings, and the results have been very successful in this respect.

The handling of big buildings and isolated-plant propositions is given special attention. Every detail is worked out by the best of talent, be he salesman or engineer, and every point is covered carefully. The results have been very gratifying and the plants grow less and less numerous each year, and Kansas City can be classed as a fairly good model of the central station town.

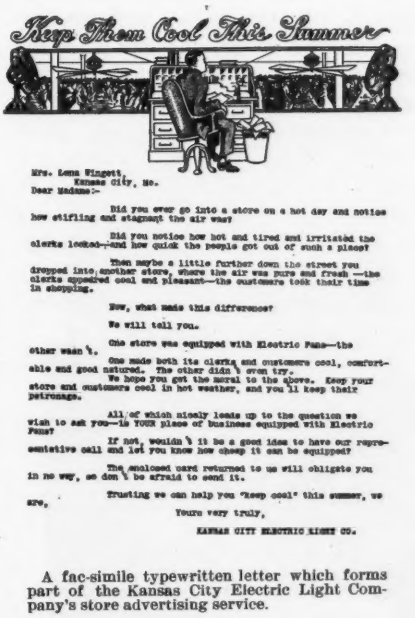
To keep everything in first-class shape and customers in good humor, inspectors are kept on duty day and night, and when any complaints are received they jump into an auto and go at once to where the trouble occurs, thus giving quick and efficient attention to all difficulties.

The company gives free lamp renewals and the broadest methods are used in installing electrical appliances. Flat-irons are put out on thirty days' free trial, and every inducement is offered to the customer.

Customers receive monthly envelope enclosures mailed with their bills keeping them posted on everything up-to-date in the electrical line.

The company recently decided to issue an "Electrical Bulletin" which will reach its customers monthly. This bulletin will be six inches by nine inches, sixteen pages, and will contain beautiful illustrations and well-written matter covering all the advantages of using electricity in the home, store, factory or business place. It is also prepared by the advertising company in charge of the lighting company's other advertising.

The company's windows are made to appeal to the passerby, for they are elegantly dressed, displaying in artistic ways the various electrical appliances. These windows have created a great deal of comment, and have attracted and interested a great many people. The company is now installing, on the top of its building, an


Keep Them Cool This Summer

Mrs. Lena Wingett,
Kansas City, Mo.
Dear Madame:-

Did you ever go into a store on a hot day and notice how stifling and stagnant the air was?

Did you notice how hot and tired and irritated the clerks looked--and how quick the people got out of such a place?

Then maybe a little further down the street you dropped into another store, where the air was pure and fresh --the clerks appeared cool and pleasant--the customers took their time in shopping.

Now, what made this difference?

We will tell you.

One store was equipped with Electric Fans--the other wasn't. One made both its clerks and customers cool, comfortable and good natured. The other didn't even try.

We hope you get the moral to the above. Keep your store and customers cool in hot weather, and you'll keep their patronage.

All of which nicely leads up to the question we wish to ask you--Is YOUR place of business equipped with Electric Fans?

If not, wouldn't it be a good idea to have our representative call and let you know how cheap it can be equipped?

The enclosed card returned to us will obligate you in no way, so don't be afraid to send it.

Trusting we can help you "keep cool" this summer, we are,

Yours very truly,

KANSAS CITY ELECTRIC LIGHT CO.

A fac-simile typewritten letter which forms part of the Kansas City Electric Light Company's store advertising service.

electric sign sixteen feet high. The sign is worded as follows:

K. C.
ELECTRIC
LIGHT
COMPANY

and the letters will each be four feet high.

Any central station man, who has read this article carefully and studied the results this company has obtained from its progressive business methods, will be convinced that it pays to be up-to-date and modern, and that good men who know their business, who are energetic, wide awake and resourceful, with the ability to systematically plan and carry out a campaign for new business, can accomplish a great deal.

The success of the new-business getting of the Kansas City Electric Light Company rests upon its efficient and capable manager, R. E. Richardson, and the wide awake and progressive director of the contract department, R. S. Bogie, and we congratulate these gentlemen and all those connected with them on the growth of the Kansas City Electric Light Company.

A Camera for Photographing the Walls of Bore Holes.

An ingenious form of camera has been devised by J. T. Atwood for examining the sides of bore holes made for scientific or mining purposes. When a diamond core drill is employed the core generally gives the principal information regarding the layers passed through, but this method of boring is several times as expensive as the so-called churn drill. The camera is designed for use in holes drilled by the latter process. The camera proper is mounted in the lower end of a water-tight tube five inches in outside diameter and forty-three inches long. Near the upper end of the tube is a plate-glass window with a mirror back of it, mounted so as to reflect the image of an object placed before the window directly down the tube and into the camera. Just beside the mirror, but shaded so as to throw light out through the window, and not downward, are two small incandescent lamps. The sensitive film is about fifty feet in length and one and one-quarter inches in width. Each exposure photographs four and one-half inches of the wall on three and five-eighths inches of the film. In use, the camera is lowered by means of a windlass into the hole. When the desired depth is reached an exposure is made by turning on the lamps for about twenty seconds. The camera is then lowered four and one-half inches, and by means of an electromagnet, the film is shifted so as to bring fresh surface into position. In this way a continuous photograph of the walls of the hole is obtained, the exposures being made at the rate of about one per minute. In use the chief difficulty is found to be in excluding moisture from the camera tube. Although the tube was exhausted and refilled with air carefully dried, when lowered into the wall, moisture condensed on the inside of the glass window, and thus obscured the photographs. When this difficulty was overcome, good results were obtained, even with the camera submerged in water.—*Abstracted from the Engineering and Mining Journal (New York), May 18.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

"American" Long-Scale Switchboard Instruments.

Recognizing the need there is for switchboard instruments suited for use with generators of large capacity and where readings must be made at a considerable distance from the switchboard, the American Instrument Company, of Newark, N. J., has recently placed on the market a new long-scale instrument which is clearly shown in the accompanying illustrations.

These instruments are provided with scales approximately fourteen inches long, or twice the length of the usual large size round pattern instrument. Owing to this there is ample room for large divisions and large figures which, together with the unique method of marking the scales (shown in Fig. 1), make them extremely clear and legible. For this reason they

FIG. 1.—FRONT VIEW "AMERICAN" LONG-SCALE SWITCHBOARD VOLTMETER.

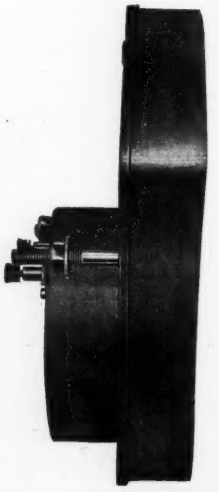


FIG. 2.—SIDE VIEW "AMERICAN" LONG-SCALE SWITCHBOARD VOLTMETER.

are particularly well adapted for use with generators of capacities running up to several thousand amperes, and also where it is essential that accurate readings be made from a considerable distance.

Perhaps the most unique feature of these instruments is the method of mounting them on the switchboard. When an instrument with a long scale as described above is mounted entirely on the front of the board it projects a considerable distance and is more or less in the way, while if the same instrument is mounted flush it requires cutting a large, irregular-shaped hole. The way in which the new instrument is constructed entirely obviates both of these difficulties. It projects less than two inches from the front of the board, and at the same time requires a circular hole only 6⅝ inches in diameter to be cut in it.

Fig. 2 shows the construction of the case, which allows for this unusual method of mounting. The instrument proper is mounted in a circular box, as shown, and this projects through the board while the shallow portion of the case contains the scale and lies flat against the front of the switchboard.

The internal construction of these new Type 3 instruments conforms strictly to the high grade of excellence which the American Instrument Company has already established in its round pattern and portable instruments. The magnets are of the best magnet steel, aged and magnetized according to the latest and most approved methods. The mechanical construction of the moving coil, its mounting, etc., are extremely simple and rugged, so that they are well adapted for the hard service which is bound to come to any switchboard instrument.

Ammeters of this new type are arranged to operate in connection with the standard interchangeable switchboard shunts, which are regularly used with round pattern switchboard instruments. These shunts are adjusted to give a uniform drop of exactly fifty millivolts on full load. Also the instrument, together with its leads, is adjusted to have exact resistance of one ohm and to give full deflection on fifty millivolts. Thus any shunt of any capacity can be used with any instrument and any pair of leads and correct results will be obtained. This feature is of great advantage, as it allows the use of any number of shunts of any capacity on one indicating instrument, the only requirement being that a suitable two-pole switch of negligible resistance be inserted in the leads between the instrument and shunts. Also, should an instrument be disabled through accident, it can be returned to the factory for repairs and properly adjusted without disturbing the shunt at all; and while it is out of commission another "American" ammeter, whether of the same or different type, may be used and correct readings obtained, when the proper multiplier is used to make the scale values agree with the shunt capacity.

These long-scale voltmeters, in common with all "American" voltmeters, whether of switchboard or portable types, are adjusted to have a uniform resistance of exactly 100 ohms per volt, so that a 150-volt instrument has just 15,000 ohms total resistance and a 200-volt instrument exactly 20,000 ohms resistance, and so on. This uniformity makes it possible to use multipliers interchangeably, should they be required, and also adapts the instrument for measuring insulation resistance and grounds most satisfactorily.

Where generators of large capacity are used there will naturally be large currents flowing in the bus-bars which will set up magnetic influences which affect the readings of the ordinary instrument. The American Instrument Company's long-scale instruments, as well as its other switchboard round pattern instruments, are, however, provided with soft-drawn sheet-iron cases, which provide an efficient magnetic shield for the internal parts, so that powerful external fields do not influence the indications. As these cases are drawn into shape the material must be of uniform softness throughout.

James G. Biddle, 1114 Chestnut street, Philadelphia, is the general sales agent for the American Instrument Company.

The Type "D" Sangamo Wattmeter for Direct and Alternating Currents.

The accompanying illustrations show several of the details of the type "D" wattmeter for direct and alternating currents manufactured by the Sangamo Electric Company, Springfield, Ill. Fig. 1 shows the regular type instrument enclosed in its metal case. Fig. 2 shows the motor element disassembled, and Fig. 3 the meter with train and damping disc removed.

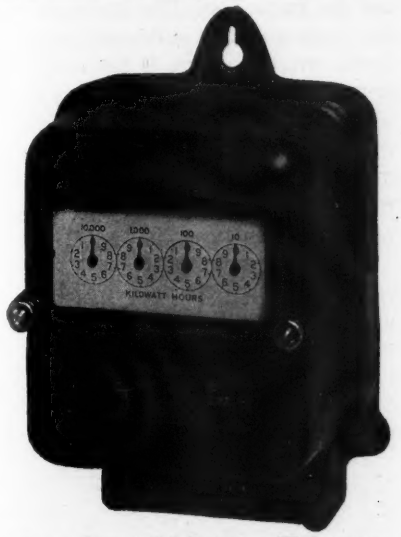


FIG. 1.—TYPE "D" SANGAMO WATTMETER.

The type "D" integrating wattmeter was placed on the market about a year ago, after several years of experimental work on various forms of mercury motor meters. The company has found a very satisfactory way of preparing the mercury before it is used, so that there is practically no deterioration in its condition after long service in the meter. The principle upon which the mercury meter is constructed is based upon the discovery made by Faraday, that when a direct current is passed radially across a copper disc having its edge immersed in mercury, and the path along which the current flows is subjected to the field of a strong magnet, the reaction between the current and the magnetic field produces rotation of the disc.

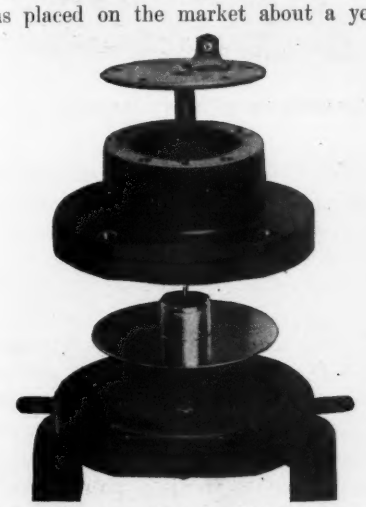


FIG. 2.—EXPLODED VIEW OF MOTOR ELEMENT OF SANGAMO WATTMETER.

The motor element of this meter comprises a thin copper disc armature with small central float, upper and lower molded insulating pieces, and a metal cover for the upper piece. On the lower piece there are two copper contact ears going through from outside to inside of the chamber, and a pair of embedded laminated steel poles, which have a return magnetic circuit in the form of a steel bar set in the upper insulating piece, but which does not show in the illustration herewith. At the centre of the lower piece, between the poles, is a steel guide ring for the lower tip of the armature spindle. The upper insulating piece is formed in such a way as to have a hopper-like receptacle at the top, where the mercury can run when the meter is turned over. The downward projecting portion of the metal covers forms, with the side wall of the upper piece, an annular chamber for the mercury when a meter is upside down, so that it does not come against the opening between the ring sapphire jewel set in the lower end of the shell, and the shaft of the armature, which passes through this jewel. When the motor element is assembled it is impossible for the mercury to be spilled, no matter how the meter may be handled. The ring jewel through which the lower shaft passes acts simply as a side guide to make a restricted opening to prevent the escape of mercury, so that the wear, under all conditions, has been found to be inappreciable. There is no jewel bearing, and, in fact, no bearing, in a true sense, at the bottom of the armature spindle, there being simply a steel guide ring at this point for holding the shaft laterally. At the top, the shaft presses upward against a carefully polished flat sapphire, the proportioning of the float on the armature being such that the thrust does not exceed thirty to forty grains.

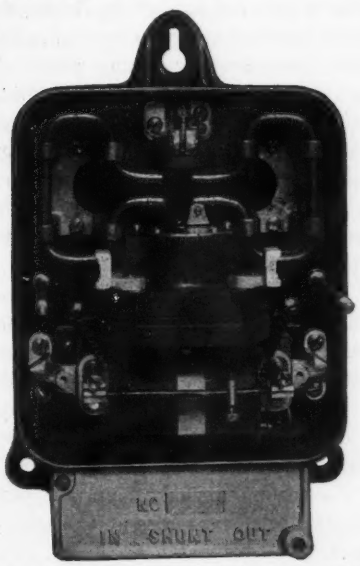


FIG. 3.—SANGAMO TYPE "D" WATTMETER, WITH TRAIN AND DAMPING DISC REMOVED.

The type "D" meter has a new style recording train and dial reading in kilowatt-hours for all sizes. The train is so designed that the main part is the same for meters of all capacities. Back of the train there is a small compound attachment which is doweled to the back of the train plate and held by three screws, so as to be readily interchangeable. This attachment carries the speed-changing gears necessary to get a direct record in kilowatt-hours for any capacity of meter, and thus, by changing the attachment, it is possible to adapt any meter for an entirely different capacity or voltage after introducing the necessary current shunt or series windings.

The type "D" meter is nine and one-half inches high over hanging lug and connecting box, six inches wide, and five inches deep from the wall to the front of the case. The meter weighs, complete with glass case, eleven pounds. The meter will, however, be furnished with the metal case, if desired.

Bristol Recording Wattmeters.

These instruments merit the attention of those who use or generate electricity, because of their ability to perform many of the functions of both indicating and integrating wattmeters, besides supplying graphically information that can not be obtained from these meters. Thus, a reading indicates the energy at the instant of observation, while integrating the area under the power curve gives an idea of the kilowatt-hours for any previous interval of time.

The special function of a recording wattmeter is, however, its continuous load diagram. A glance at its chart shows every fluctuation of energy and a comparison of charts, the fluctuation from week to week; the time and amount of maximum and minimum load, average load, etc. This information is, of course, valuable for increasing the load factor of

central stations, making and adjudicating light and power contracts, analyzing power consumption on different parts of systems, and checking the efficiency of operation.

The exterior appearance of a Bristol recording wattmeter is illustrated in Fig. 1, but the extremely simple interior construction is shown in Fig. 2; the case and clock cover having been removed.

FIG. 1.—EXTERIOR VIEW OF BRISTOL RECORDING WATTMETER.

The coil A wound with fine wire is capable of motion in the direction of its axis, being supported by a shaft one end of which rests on a frictionless knife-edge

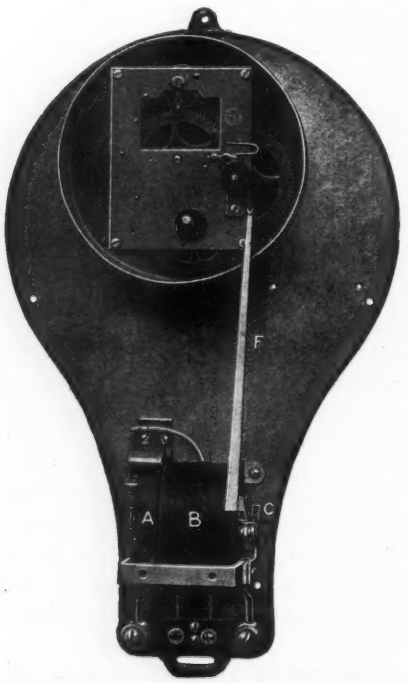


FIG. 2.—INTERIOR ARRANGEMENT OF BRISTOL RECORDING WATTMETER

bearing, while the other end is supported by a vertical steel spring. This coil is wired across the line in series with an auxiliary resistance of zero temperature coefficient.

The coil B is stationary and designed to carry the total current, or some definite proportion of the total. The magnetic field produced by current flowing in coil A is proportional to the voltage, while current flowing in the low-resistance coil B produces a field proportional to the amperes. The mutual attraction of the two coils is the product of their field strengths and causes a motion of coil A proportional to the watts. The pen-arm C receives its motion direct from the knife-edged spring supporting coil A and operates on a properly graduated chart, driven uniformly by clockwork.

By using this electric balance principle the instruments are unique, in that permanent magnets have been absolutely dispensed with; also make and break contacts which are subject to depreciation. Jewel bearings have also been eliminated, since there are no turning parts. The only friction possible is that of the pen on the chart, which is negligible, as a record will be made even with an inappreciable pen pressure. These wattmeters will therefore respond to the slightest changes in energy and are not subject to light load errors.

The charts used are eight inches in diameter, being uniformly divided for alternating current, and almost uniform for direct current. The round form of chart is convenient, as it bears the complete record for a day or week and is easy to read, handle and file.

Wattmeters for direct current can be supplied in all capacities up to 10,000 amperes.

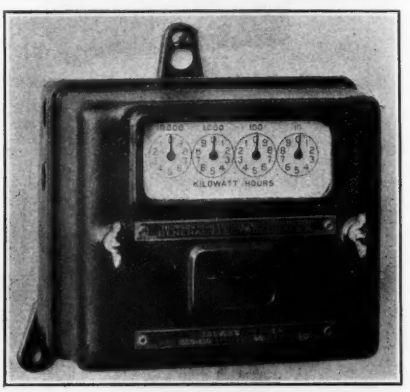
For alternating current it is generally the practice to use potential and series transformers if the voltage or current is heavy, the wattmeters being wound for 125 volts and five amperes maximum. On single-phase one current and one potential transformer are required, but for three-phase two potential transformers are necessary. Any standard make of instrument transformers of the proper ratios are satisfactory.

These instruments are manufactured by the Bristol Company, Waterbury, Ct.

Thomson Wattmeters.

The General Electric Company, Schenectady, N. Y., manufactures three types of single-phase, high-torque induction wattmeters, as follows: type I, metal cover, for house installation; type IS-2, metal cover, for switchboard use; type IS-3, glass cover, for switchboard use. In these wattmeters the company has succeeded in obtaining a continued maintenance of the initial accuracy under all ordinary circumstances. The mechanism is contained in a rectangular case which is provided with three supporting lugs or feet. The cover is of pressed sheet aluminum, with two rectangular windows sealed in, providing means for observing the register and the meter disc. The entire mechanism is assembled on a skeleton casting or frame, which, in turn, is fastened to the meter case. By removing two retaining screws and the two sealing studs, the frame and mechanism can be removed for inspection or repair. By removing the register and pivot, the moving element can be taken out.

These meters are so designed that the magnetic circuit is practically closed upon itself, and stray fields, which might tend to demagnetize the magnets, are reduced to a minimum. All of the General Electric induction meters are designed so as to prevent "creeping" or rotating on po-



THOMSON HIGH-TORQUE INDUCTION WATTMETER—TYPE I.

tential alone. The rotating disc contains two small holes placed near the periphery and diametrically opposite each other. These holes increase the resistance to the flow of the eddy currents in the disc. When these openings are in the neighborhood of the potential pole, any tendency to rotate on potential alone is overcome, and the disc is therefore prevented from rotating more than half a revolution. When current is flowing in the series coils, rotation of the disc is in no way affected, nor the accuracy of the meter impaired.

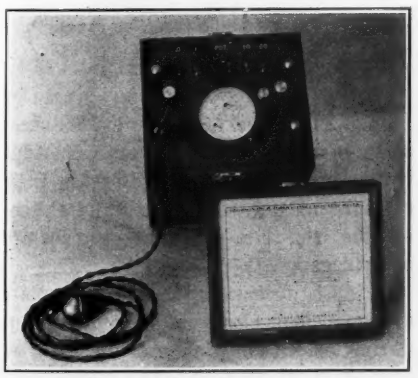
The type I meters are manufactured as standard devices for two-wire and three-wire service and for direct connection into circuits up to and including 300 amperes, two-wire, and 150 amperes, three-wire. Current transformers are not used unless the current is above these limits, or the voltage greater than 650 volts. Potential transformers must be used above 650 volts. Type IS-2 and type IS-3 meters are

standard in capacities up to 150 amperes, for 1,150 and 2,300-volt circuits. When used on 650-volt circuits, and over, they are furnished with potential transformers, and for 2,300-volt service are supplied with both current and potential transformers.

The Thomson recording wattmeter embodies three necessary elements, namely: a

THOMSON RECORDING WATTMETER—TYPE C-6.

motor, causing rotation; a generator, providing the necessary load or drag; and a registering device, the function of which is to integrate the instantaneous values of the electrical energy passing in the system to be measured. The meter is sup-



HIGH-TORQUE INDUCTION TEST METER—TYPE IB.

ported by three lugs, the upper one being key-holed, and the lower right-hand one slotted. This permits of accurate and rapid leveling, as the top screw can be inserted and the meter hung thereon approximately level. The right-hand screw may then be placed in position and the meter adjusted as may be required before forcing the screw tightly home. The register is of the four-pointer type, registering directly in kilowatt-hours in all sizes up to thirty kilowatts. In meters of capacities of thirty kilowatts or above, a dial constant of ten, 100, 1,000, etc., is required. The dial face is made of porcelain having a dull finish.

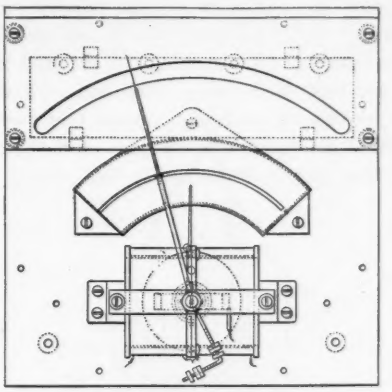
For periodical meter calibration, the company offers the type IB high-torque induction test meter. An illustration of this meter is shown herewith. In using the meter it is unnecessary that the load shall be constant, as the only observations necessary are the number of disc revolutions of the meter undergoing test, and the pointer indications of the standard meter before and after test.

The test meter is enclosed in a wooden carrying case provided with a substantial strap. The case is made from quarter-sawed oak with antique finish. It is ten inches by eight inches by seven inches in over-all dimensions.

The register of the test meter is large and easily read, and is placed on top of the instrument. This feature is particularly advantageous when making tests at points of installation, where there is no opportunity to hang up the meter, but where it must be placed on the floor or some other place below the observer.

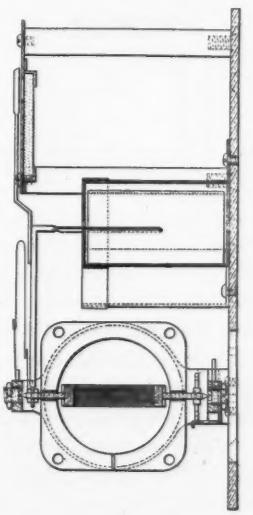
Keystone Electrical Measuring Instruments.

The measuring instruments here described, made by the Keystone Electrical Instrument Company, Philadelphia, Pa., are constructed on the principle of the electro-dynamometer, which principle is based on the mutual attraction between two coils through which the current passes, one of which is fixed, the other movable. As the law governing this type of instrument is the law of current squares, in the case of voltmeters, equally divided scales can not be obtained. In the case of wattmeters, the scale is approximately equally divided, due to the fact that the movement of the moving coil is proportional to the product of the current in the fixed and moving coils. The moving parts have been made as light in weight as is consistent with mechanical strength, and the entire moving system is supported in jeweled bearings. The motion of the pointer is rendered aperiodic by the use of an aluminum air vane moving in a partially enclosed air chamber. This method of damping the oscillations of the moving parts renders unnecessary the use of mechanical brakes or other frictional devices, which tend to impair the accuracy of the instrument.



PLAN VIEW OF KEYSTONE ELECTRO-DYNAMOMETER INSTRUMENT.

The spring system of the instruments consists of one spiral spring and a spring



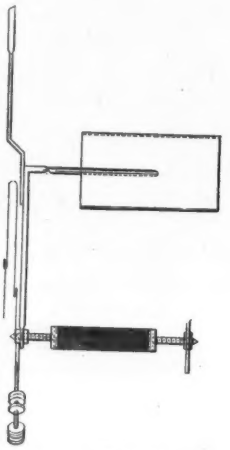
SECTIONAL VIEW OF KEYSTONE ELECTRO-DYNAMOMETER INSTRUMENT.

which is termed a pendulum spring. These two springs are so related to one

PLAN VIEW OF COIL AND POINTER OF KEYSTONE ELECTRO-DYNAMOMETER INSTRUMENT.

another that the pointer, when at zero, is held in what may be termed a dynamic

state of rest, rather than in a static state of rest. The spiral spring uniformly opposes the movement of the moving coil, while the pendulum spring assists the movement of the moving coil through the first half of the scale, then acts with the spiral spring and helps oppose this movement through the second half of the scale. From this it follows that the control is

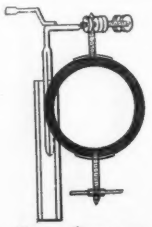


Sectional View of Pointer, Moving Coil and Damping Vane.

weak when the deflecting forces are weak, and automatically increases in strength as the deflecting forces increase in strength.

The company has succeeded in producing a line of instruments in which, it believes, the proportions between the fixed and moving coils, and the proportions between inductive and non-inductive resistance, are nearly perfect. In a wattmeter, the self-induction error in the moving coil on a 150-volt, 133-cycle circuit is 0.00013 per cent.

The illustrations herewith show, respectively, a plan view of a portable volt-



End View of Coil, Springs, Pointer and Damping Vane.

meter, a section through the centre line of the plan view, and the moving elements, showing the pointer, damper and springs. The illustrations show a voltmeter, which differs, however, but little from a wattmeter. In the case of a wattmeter, the fixed coils are connected in series with the line, either directly or through a series transformer, while the moving coil is connected in shunt to the line.

Hart Manufacturing Company Switches.

The Hart Manufacturing Company, of

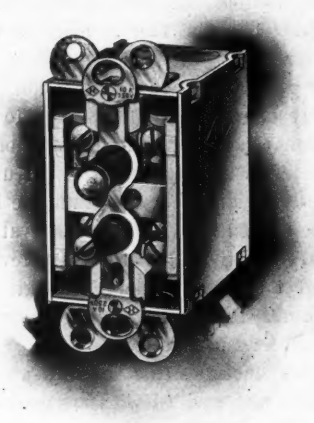


Fig. 1.—Push-Button Switch.

Hartford, Ct., which for a number of years has demonstrated its ability to manufacture switches and appliances of ex-

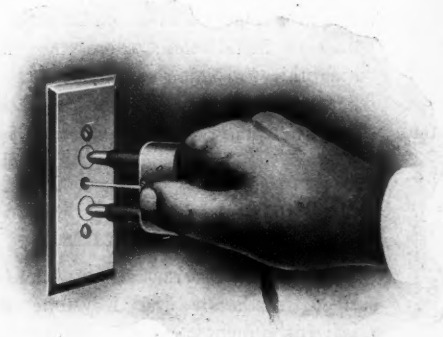


Fig. 2.—Flush Receptacle with Plug Ready to Insert.

ceptional merit, has recently made a number of changes in the construction and design of certain of its products, which

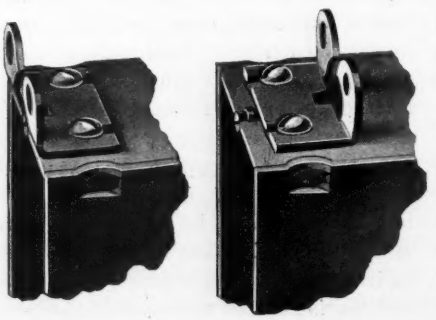


Fig. 5.—Reversible Ear on No. 81 Case.

makes their use even more advantageous than it has been in the past.

Particular attention is called to the "Diamond H" flush push-button switch, illustrated herewith, which has the mechanism entirely enclosed in a porcelain chamber which effectually excludes all

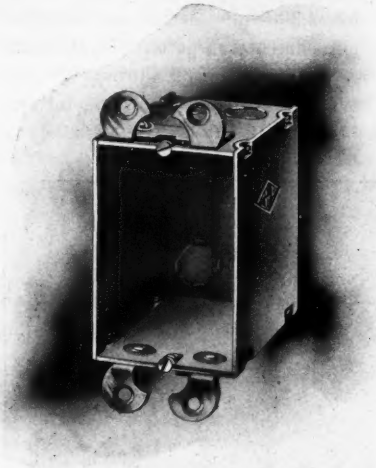


Fig. 4.—No. 81 Wall Case.

plaster and dirt before the face-plate has been put on. The binding-screws and push buttons only are exposed, and the

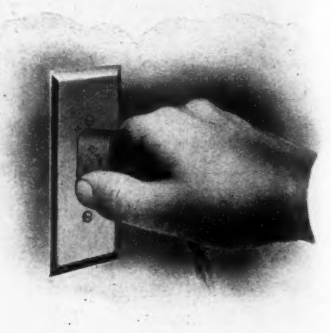


Fig. 3.—Flush Receptacle with Plug Inserted.

possibility of the switch being injured by foreign substances getting into the mechanism is reduced to a minimum. A bridge is also used to keep the buttons in their normal positions, which facilitates attaching the face-plate when the switches are used in gangs.

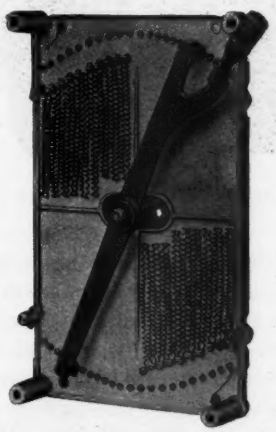
A flush receptacle with a face-plate which opens or closes automatically by inserting or withdrawing the plug, is also a product of this company. The construction is such that it is impossible to cause a ground or short-circuit with the plug, which insures a freedom from accident. The illustrations herewith show the ease of operation, as it is only necessary to insert the pilot-key in the small slot in the face-plate and push. The plug automatically seats itself in the proper position.

"Diamond H" wall cases are designed

for use with "Diamond H" flush switches and receptacles, and are of an advanced type of construction, securely put together without rivets and galvanized by the hot process to prevent rusting. They have recently been fitted with reversible ears which make them suitable for use on either old or new work. The ears are readily reversed, as they are held in position by two screws as shown in the illustration, a screw-driver being the only implement necessary. The cases are practically indestructible, and like all the rest of "Diamond H" material are guaranteed by their makers to be right in every particular.

The Ward Leonard MP Battery-Charging Rheostats.

The accompanying illustration shows the new type MP battery-charging rheostat which has been placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y. These rheostats, it is claimed, have at least four times as wide a range of charging current as ordinary charging rheostats. The illustration herewith shows the MP-140 rheostat, which can be used to charge any ordinary-sized automobile or any number of cells from one to the limit of the charging voltage, or any ignition storage battery with any number of cells, and at any desired rate



Ward Leonard MP Battery-Charging Rheostat.

from four amperes to forty amperes, on a 125-volt circuit. All sparking has been avoided by using such a large number of steps that the difference in potential between the consecutive steps has been reduced to a point below that at which any arc can occur.

In ordering the proper rheostat, it is only necessary to know the maximum amperes at which it is desired to charge, and the line voltage of the charging circuit.

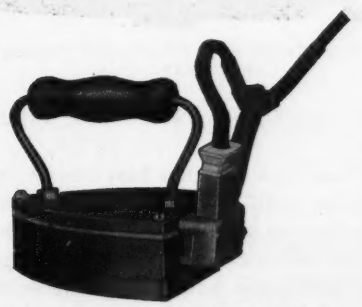
The W. J. Barr Electric Manufacturing Company's Irons and Heating Devices.

The W. J. Barr Electric Manufacturing Company, Cleveland, Ohio, has added several improvements to its electric flat-irons and sad irons, and has also made additions to its line of electrical heating apparatus. Particular attention is called to the new plug switch iron, an illustration of which is shown herewith. This iron is becoming very popular on account of the disconnecting plug switch, which enables the operator to turn the current on and off at the iron.

The company also makes automatic irons, travelers' irons, domestic irons of several sizes, laundry and hotel irons, polishing and seaming irons, electric glue pots, soldering irons, electrotypers' building irons, curling irons, coffee percolators, chafing dishes, electric heating stoves and disc heaters, broilers and electric griddles and heating pans.

The newly developed electric glue pot is of particular interest. This glue pot is made in one piece from an aluminum casting. An aluminum casting is used for the reason that glue will not stick nor burn around the edges, and the casting is also lighter for portable use. By the method of electric heating applied with this pot, it is not necessary to provide a water jacket, as the glue is never heated beyond the proper temperature. This feature will be appreciated because of its economy in current consumption.

The following capacities and consumptions are given: one quart, eighty watts;



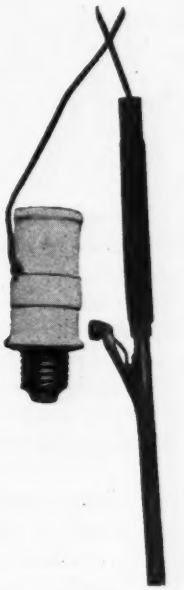
Barr Plug Switch Domestic Iron.

two quarts, 117 watts; four quarts, 170 watts.

A feature of all the heating devices manufactured by this company is that the heating coils are easily reached in case of accident, and are light enough to be sent back to the factory by mail when anything goes wrong. With the new winding of the coils these heating appliances have extremely long life, and repairs, it is thought, will not be very frequent.

Caven Electric Curling Iron and Electric Sterilizer.

The accompanying illustration shows the parts of an electric curling iron placed



Caven Electric Curling Iron.

on the market by the M. E. Caven Manufacturing Company, of Kansas City, Mo. This iron is made for use on 100, 104 and 110-volt circuits, in series with a sixteen-

Caven Electric Sterilizer.

candle-power lamp. On 220-volt circuits the iron is used in series with a thirty-two-candle-power lamp. The iron takes

from six to seven minutes to get up to a curling heat. A detachable fixture containing a receptacle and plug, together with about six feet of cord, is furnished with these heaters.

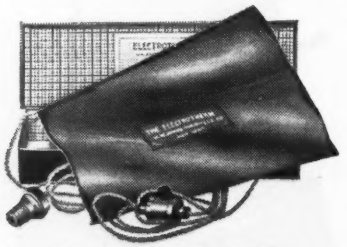
An illustration is also shown of the sterilizer made by this company. This sterilizer may be used either for wet or dry sterilizing, and the flow of current is so regulated that the intensity of the heat may be varied from 200 to 400 degrees Fahrenheit. The apparatus is arranged to operate on either 110 or 220-volt direct or alternating-current circuits. The sterilizer can be brought very quickly to a boiling temperature, and by a reversing switch, held at the boiling point.

The curling iron illustrated herewith consumes, in series with a sixteen-candle-power lamp, about thirty-three watts, which makes the cost about 0.33 cent per hour with current at ten cents per kilowatt.

The dental sterilizer consumes, on the high heat, 300 watts; on the low heat, sixty watts. The sterilizer is also made in aurist's and surgeon's sizes, consuming 500 watts on the high heat, and 100 watts on the low heat. The high heat is used only to bring the water to a boiling temperature, which may be done in from three to seven minutes, according to whether the sterilizer is wound for fast or slow heating. The sterilizers are finished in quadruple matt silver plate, which does not discolor under heat.

The "Electrotherm."

The accompanying illustration shows the "Electrotherm," placed on the market by the H. W. Johns-Manville Company, New York city. The "Electrotherm" is composed of wires insulated and protected by asbestos, woven into a thin, light and



THE "ELECTROTHERM."

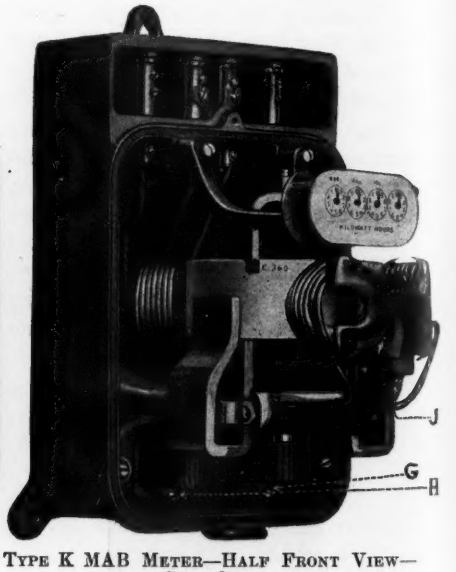
flexible sheet or pad, which, when connected to the ordinary incandescent lamp, offers sufficient resistance to the current to produce a constant and uniform degree of heat. The size best adapted to general use is eleven by fifteen inches, and one-quarter inch thick. It is provided with regulating switch, connecting plug and fifteen feet of flexible conducting cord, with coverings suited to various purposes. It is made for any voltage from five to 125, and can be used with either direct or alternating currents.

The company states that these pads require no more current than a sixteen-candle-power incandescent lamp. The cost of maintaining a constant heat does not exceed one cent per hour, and the device can be connected to any electric light fixture.

Fort Wayne Wattmeters.

The Fort Wayne Electric Works, Fort Wayne, Ind., has placed on the market the type K wattmeter as multiphase induction integrating instruments, single-phase integrating instruments, prepayment instruments and high-torque, single-phase instruments. The company also manufactures integrating switchboard wattmeters.

MAB METER WITH SEPARATELY SEALED COMPARTMENT OPEN.



TYPE K MAB METER—HALF FRONT VIEW—CASE OFF.

These type K meters have become very popular with central-station managers. The features of design and internal mechanism are common to both single-phase and multiphase meters. The multiphase meter might be considered as two single-phase meter fields operating upon a single rotating element, in such a manner as to record upon a single register the combined work in watt-hours which is being done in all phases of the multiphase circuit to which the meter is connected. The form MAB wattmeter is of the separate seal pattern, in which the connections between the circuit and the motor are made entirely within a separate weatherproof compartment at the top of the meter, which is provided with a seal entirely distinct from the seal which protects the mechanism of the meter. This meter is illustrated herewith.

The MAB meters are provided with two cases or covers, made of cast aluminum. The larger of these cases protects the mechanism of the meter, and the second cover protects the terminal compartment. Both cases are easily removable without in any way disturbing the position of the meter upon the wall.

Multiphase type K wattmeters are made in three, five, ten, twenty-five, fifty, seventy-five, 100 and 150-ampere capacities without current transformers, except above 600 volts. These sizes are standard. Larger capacities require current transformers, and are special, except for switchboard meters over 600 volts, which are standard up to 200 amperes, but require current transformers for all capacities to exclude the high voltage from the interior of the meter. These meters are supplied for both three and four-wire distribution from two-phase circuits, as well as for three-wire distribution from three-phase circuits. The standard voltages for these meters are 110, 220, 440, 550, 1,100 and 2,200, and they operate on circuits of twenty-five, forty, sixty, 125 and 140 cycles.

The SAB wattmeter has a separate compartment in which the binding posts are contained, which may be sealed independently of the meter case. The meter is a compact light-weight instrument designed to meet actual requirements of practical service. It weighs thirteen pounds, and can be installed in a space six and three-quarters inches by eight and seven-eighths inches by six and three-

eighths inches. The frame is provided with three lugs for support. The top lug is key-holed, and one lower lug is slotted, so that in dismounting the meter but one screw must be removed. Connections with the circuit are made at the side of the meter and at the top. The instrument is fitted with large dials arranged on a straight line on dull-finished porcelain. The dial mechanism is supported on a bracket mounted on the upper part of the frame. The upper bearing for the revolving shaft is also mounted on this bracket.

The case of the meter is a single aluminum casting. The name plate is cast on the case, and serial numbers and other data are stamped on the raised portion. The meters are so constructed that it is possible to repair or replace any worn or injured parts at a low cost, not only for material but for labor and loss of service. The jewel bearing is standard in all meters, and can be quickly removed and replaced.

The construction of the meters renders them dust-proof. The felt packing on which the case is seated in a groove in the base is applied by doubling a strip and cementing both edges to the bottom of the groove, so that the edge of the case impinges directly on a depressed cushion without loosening the felt from the base.

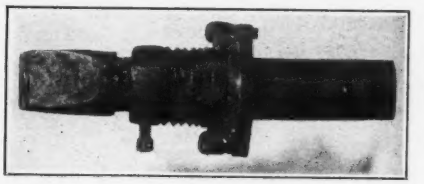
The prepayment wattmeter is of the same construction as the meters just described. The prepayment device does not limit, in the least, the use of the meter as an ordinary integrating wattmeter. The readings may be taken at regular intervals if so desired. The prepayment portion of the meter is so arranged that twenty coins may be inserted, crediting the user with whatever portion of energy this amount demands. After the twenty coins have been deposited, the slot is closed, which prevents the insertion of another coin until that portion of the energy demanded by the unit coin has been used. In order to adapt the prepayment wattmeter to the many different rates charged for energy per kilowatt-hour in different localities, the meters have been designed so that any rate up to twenty cents per kilowatt-hour may be obtained by a simple operation. The power necessary to operate the prepayment device is given to it by the consumer in the operation of crediting his coin, a spring movement being involved. The tripping of an escapement motion is the only operation actually performed by the wattmeter itself.

ENCLOSED ARC SOLDERING IRONS.

BY H. C. HEIDRICH.

An interesting experiment of proven practical value has been made in the use of the electric arc applied directly to the heel of soldering-iron tips, as shown in the accompanying illustration.

A number of these irons were constructed and used in a shop where a series arc machine was employed for testing purposes and general service. The irons behaved remarkably well for this character of service, which was peculiarly adapted



AN EXPERIMENTAL ELECTRIC-ARC SOLDERING IRON WITH ONE SET OF RADIATING FLANGES.

for their use as the starting of the iron necessarily required, as is customary with all arcs, an actual contact, causing what would be commonly termed "short-circuit," which, in the case of series arc machines made practically no difference, as the machine compensated for every change of voltage across any gap such as caused by an arc, similar to the arcs of lamps.

In electrical repair and manufacturing establishments there are many applications for a first-class heavy soldering iron which will maintain a good glowing heat for the flowing of hard solder on armature leads and other parts of apparatus, as the system of heating irons in a gas flame is both tedious and unsatisfactory, not to mention loss of time in passing irons, general inconvenience and varying temperature, which would necessarily cause a difference in soldering unless the operator were fairly skilful in the use of soldering irons and could determine just when the irons were really hot enough to flow solder into the fullest depths of any armature or commutator bar. In the use of the enclosed arc soldering iron, however, which is intended more for heavy than for light work, no such conditions could exist, as this iron is capable of maintaining a higher temperature for a very much longer period than the ordinary soldering iron heated in the usual way, the heat of the former being under the control of the operator by varying the arc, which is accomplished by an occasional adjustment of the arc, which can be seen through small peep-hole in the side of the iron head, and after the operator becomes skilled in the use of the iron it will become practically second nature for him to know when to change the arc, for the slightly varying temperature of the iron can be instantly noted, due to change in color.

The accompanying sketch shows the general construction of the iron, which, of course, can be modified to meet special requirements. The tip of the iron shown in the sketch would be suitable for ordinary work, but special shapes, and sizes of tips, having the same end adapted to fitting, could be constructed to meet every requirement. As before stated, the arc is employed direct to the base of the tip of the iron, the principle of the iron being that of the long-burning arc lamp.

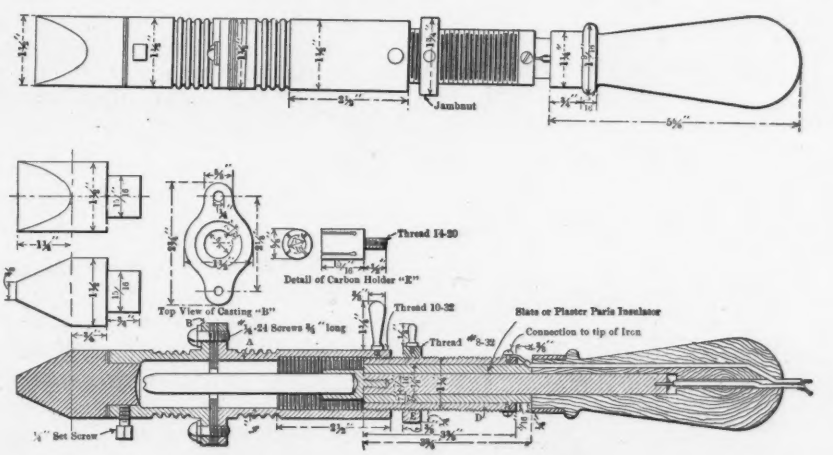


FIG. 1 AND FIG. 2.—DETAILS OF ENCLOSED-ARC SOLDERING IRON.

Fig. 1 shows the general appearance of the iron without conductors. Fig. 2 shows the iron in section. Attention is called to Part "B." Immediately to the right of this figure vertical section lines are shown extending through the entire base of "B." The material used in this should be sheet

mica, it being found in practice that this was necessary in order to retain the heat at the tip and also to prevent the heat following too far up the handle, the circuit being established by a small bond of sheet iron one-eighth inch wide by about one-half inch long being placed around the mica forming contact with the main body of the iron and the tip, the 12-24 machine screws shown in the sketch being provided with mica washers under the head so as to further prevent the passage of heat from the tip of the iron to the back casting or main body of the iron.

The carbon-clamp, made of five-eighths-inch round brass rod, is shown in Part "C." This is the well-known split ferrule type of holder, seven-sixteenths-inch solid carbon being employed.

The construction of the iron is as follows: The tip is, of course, of copper. Castings "A" and "B" are of iron. The radiating ribs shown in the drawing are rounded, but this is not necessary; a regular thread form may be employed instead of the round shapes shown. These radiating flanges have been found necessary in the original experiment, owing to the intense heat maintained by the parts. After the introduction of these radiating flanges the iron was found to work much more satisfactorily.

Casting "A" is to be bored and threaded, and fitted with a small brass handle, as shown.

"D" is a one and one-quarter-inch brass tube with three-sixteenths-inch wall, the tube being three and three-eighths inches long, threaded to within one-quarter inch of one end to provide for its fitting freely into casting "A."

"E" is an ordinary ring nut, having a small brass handle to facilitate manipulation.

Attention is called to section marked "Slate, or Plaster of Paris Insulator." This part of the iron is a very essential feature, and one found very necessary in practice to be of a fire-resisting material. Both materials have been tried, plaster being preferred, although the slate is somewhat stronger. The plaster is poured and allowed to set firm before the iron is handled, which, of course, would be apparent to any mechanic. If slate is used, it would only be necessary to secure a good, dense piece of that material.

The centre of the iron is of seven-sixteenths-inch iron rod, of the length shown in the drawing. The conductors should be of No. 12 wire or cable introduced as illustrated, the handle being of maple, or other good hardwood, protected with a ferrule.

The iron is started by slacking the ring nut "C," holding the handle "A" and turning the main handle of the iron about one full turn, closing the circuit between the copper tip and the carbon, and then turning the handle in the reverse direction for the same distance, thereby establishing the arc.

When irons of this kind are employed on series arc circuits it is obvious that all the tips and carbons must be together in order to close the circuit, or, in the event of this not being the means employed, the usual form of arc lamp cutout, mounted separately and in connection with the iron, could be used; this would prevent the occurrence of an open circuit.

Another feature which must be borne in mind when irons of this kind are used on series arc circuits is the fact of the tip being part of the circuit. The shop where the experiment was made having but very few lamps, there was not a great difference of potential, and had a ground occurred, it would have made practically no difference, since everything else was thoroughly insulated.

The irons give excellent satisfaction on all general work and especially on armatures and commutators.

The irons have not been tried on alternating current or constant potential direct-current circuits, but it is quite certain this current can be used with an external resistance.

It has been found that the proper current should be about nine amperes with a drop of from twenty to forty volts across the arc.

A reproduction of a photograph showing the first experimental iron constructed with but one set of radiating flanges, is shown herewith.

An Equalized Electromagnet.

A method of equalizing the pull exerted by an electromagnet through a considerable travel of its armature has been patented in England by R. Macgregor. A brief description of the device is given in the *Mechanical Engineer* (London), May 4. The object sought here is to reduce the length of the air-gap when the armature is all the way out, and yet retain a long travel. The method here employed makes use of a magnet of the coil and plunger type, but allows both portions of the core to move. The armature proper is attached in the usual way, and is drawn into the solenoid. The core portion, however, which is usually fixed, is here mounted so that it may also be drawn in against the action of a compression spring. The effect of this is that when the current is first applied, the force set up upon this core causes it to be drawn into the solenoid, thus reducing the gap between this core and the armature. The armature is then drawn up, and after it has come into contact with the core, the spring compressed during the first part of the action is still in reserve for moving the core and armature still further in the same direction.

The Advertising Show.

The second annual advertising show held at Madison Square Garden, New York city, May 16 to May 23 was a great success. Electrical advertising features are becoming more and more numerous, and there were on exhibition several devices which depend primarily upon either electric light or electric motive power for their operation. C & C, Crocker-Wheeler, Lundell, General Electric and Westinghouse motors were noticed, driving presses, punching machines, wire stitchers and similar apparatus.

Among those exhibiting electric signs were the Advertising Mirrorgraph Company, C. P. Gates, George L. Mason Company, L. D. Nelke and the Thermo-Electric Company.

The Technical Publicity Association had a reception room, where friends of the association were received.

Columbia Incandescent Lamp Company Conference of Salesmen.

The Columbia Incandescent Lamp Company held its annual conference of salesmen at its main office and factory in St. Louis, Mo., on May 23, 24 and 25. The sessions were attended by a full representation of the company's salesmen and managers from all over the country, and the general sentiment was that the prospects for the coming season were very bright in every territory. The sessions followed the usual custom of devoting the mornings and afternoons to business discussions, and spending the evenings visiting the summer gardens and theatres, and attending informal dinners.

A Dustless Sweeping Compound.

The H. W. Johns-Manville Company, New York city, announces that it has acquired the exclusive sales agency for "Perolin" throughout the United States. "Perolin" is stated to be an ideal fireproof floor-cleaning compound. This compound absorbs the dust, drawing it from cracks and crevices and from carpets and rugs. It is a powerful disinfectant, destroying disease germs common with dust, leaving the air pure and wholesome and the floor clean.

Current Electrical News

DOMESTIC AND EXPORT.

CONCESSION FOR NEW GERMAN CABLE—The German Atlantic Cable Company has received a concession from the Spanish government for a third cable from Emden to New York, using Teneriffe, Canary Islands, as an intermediate station.

LONG ACRE ELECTRIC LIGHT AND POWER COMPANY—At the meeting of the directors of the Long Acre Electric Light and Power Company on May 22, John C. Sheehan, Edgar E. Van Etten, Henry B. Harris, W. H. Lamprecht and G. Tracy Rogers were chosen as the executive committee. The directors announced the purchase of property at 120th street and the Harlem river as a site for a proposed new 100,000 horse-power station. This property, together with a Forty-second street site, will give the Long Acre company holdings of $500,000 in real estate in New York city.

GOULD INTERESTS PLAN CALIFORNIA POWER DEVELOPMENT—A new power company has purchased a large tract of land in East Oakland, Cal., where the plant which is to mark one of the important links in the chain of power stations which the corporation has planned is to be constructed. The company has extensive plans for the development of its main sources of supply, which are located in the Sierra Nevada Mountains. The enterprise is closely identified with the Western Pacific interests in New York city. At the head of the new company are Edwin Hawley and other representatives of capital who are concerned directly in the Gould railway development.

THE NEW YORK-NEW JERSEY TUNNELS—President McAdoo, of the Hudson & Manhattan Railroad Company, announced last week that he expects to have the upper tunnels, those extending under the river from Hoboken, N. J., to Christopher street and Sixth avenue, New York city, ready for operation on or before October 1. By that date the tunnel will be open on the New York side as far as Fourteenth street and Sixth avenue. The rest of the road to the proposed Thirty-third street terminal will be rushed forward as rapidly as possible. The two lower tunnels connecting the Pennsylvania Railroad station in Jersey City with the big terminal at Church and Cortlandt streets are fast approaching the New York shore, seventy-five per cent of the distance under the Hudson having been penetrated by the tubes. There is considerable rivalry between the tunnel workers, as to which of the tubes shall be the first to penetrate Manhattan soil. Only a small section of work on the upper tunnels remains to be completed.

ORGANIZATION OF THE EASTERN COLORADO POWER COMPANY—Colorado Springs capitalists have filed articles of incorporation of the Eastern Colorado Power Company, a subsidiary concern of the $22,000,000 Central Colorado Power Company. The new concern was organized by Curtis & Hine, of Colorado City, and capitalized with $7,500,000 to develop power in the North and South Platte, the Big Thompson, Clear Creek and other streams of the state, in seventeen counties lying east of the mountain ranges, and sell the same as far north as Cheyenne, Wyo. The directors of the company include J. A. Hayes, Irving W. Bonbright, Henry Hine, Leonard Curtis, George R. Buckman and O. B. Wilcox, of Colorado Springs, and Myron T. Herrick, former governor of Ohio, besides several New York capitalists. The company also expects to build reservoirs for the development and irrigation of any arid tracts in the eastern parts of the county. It is said that the company will purchase, the plant, property and rights of the Union Hydroelectric Company, of Georgetown, Col.

THE TOLEDO PUBLIC UTILITIES MERGER—New York city interests of the Toledo Railways and Light Company state that the terms of agreement covering the acquisition of the Toledo Gas, Electric and Heating Company by the company which the stockholders are asked to approve at the special meeting to be held June 10, call for the exchange of three shares of capital stock of the Toledo Railways and Light Company for four shares of the capital stock of the company to be acquired. The total authorized capital of the Toledo Gas, Electric and Heating Company is $2,500,000, of which there is now outstanding $2,200,000. It is believed it will be possible to acquire all of this outstanding stock. The proceeds from the proposed increase of $3,000,000 in the capital stock of the Railways and Light Company will be considerably more than sufficient to acquire the stock. The Toledo Gas, Electric and Heating Company was organized in 1905 as a consolidation of two lighting companies then doing business in Toledo. Since its organization the company has materially increased its plant. The Toledo Railways and Light Company also engages in a lighting business and has the contract for lighting the city's streets. The consolidation of the two companies should bring about considerable saving in operating cost. During the year ended December 31, 1906, the Toledo Railways and Light Company earned 3.89 per cent on its $12,000,000 capital stock, as compared with 3.58 per cent earned during the previous year.

NORTH AMERICAN COMPANY ISSUES $5,000,000 IN FIVE-YEAR, FIVE PER CENT NOTES—The North American Company has sold to a syndicate, headed by Redmond & Company, of New York, and Lee, Higginson & Company, of Boston, $5,000,000 five-year five per cent notes to refund the company for its loans to its subsidiary companies and supply the latter with more working capital. The notes are secured by the deposit of securities of the Laclede Gas Company and the Union Electric Light and Power Company of St. Louis. The shares of the latter company, which are not paying dividends at present, will, it is said, be put on a six per cent basis this year. The following official statement was given out by the company: "The subsidiary companies owned by the North American Company are largely in debt to that company, and besides need large sums to meet the rapidly increasing business. There is practically no market for the bonds of the subsidiary companies except at ruinous prices, and the North American Company directors believe that it is better financiering to sell short-time notes in order to help its subsidiary companies rather than sell the long-time bonds of these companies at low prices. The bonds of the subsidiary companies will be held in the treasury of the North American Company until such time as the market for investment bonds may assume normal conditions." The notes will be offered at about ninety-three and one-half and interest, and are redeemable after two years at 101 and interest. St. Louis newspaper despatches announce, simultaneously, that most of the new issue will be used to extend and improve the United Railways system in St. Louis and that an ouster suit has been filed in the circuit court by Circuit Attorney Sager against the Laclede Gas Company and the Union Electric company, charging them with violation of the anti-trust laws of Missouri, and alleging that they have formed a monopoly of the lighting utilities of St. Louis.

MERGER OF SCHOEPF INTERSTATE INTERESTS ALLEGED—According to a report from Cincinnati the various Schoepf syndicate interurban properties will be merged into one large corporation to be known as the Ohio Electric Railway Company, which was incorporated Thursday, May 16, in the office of the secretary of the state. The capital stock is given at $100,000, which is merely a nominal figure, but when all the details of the merger have been completed the company will have a capital of between $50,000,000 and $75,000,000 and about 1,200 miles of high-grade traction lines. The incorporators are E. H. Berry, H. D. Downing, S. M. Murray, W. H. Schubert and C. W. Wilson, all employés in the office of Mr. Schoepf. The termini of the road will be at Zanesville, Muskingum county, and New Paris, Preble county, and will extend to Richmond, Ind.; Cincinnati, Toledo, Columbus, Washington C. H., Springfield, Defiance, Dayton, to near Union City, on the Ohio and Indiana state line; to Lima and Tully township, in Van Wert county; Fort Wayne, Ind.; passing through Muskingum, Licking, Franklin, Madison, Clark, Greene, Montgomery, Preble, Hamilton,

Butler, Warren, Champaign, Logan, Auglaize, Allen, Putnam, Defiance, Henry, Wood, Lucas, Pickaway, Fayette, Drake and Van Wert counties in Ohio, and Wayne and Allen counties in Indiana. There will be branch lines from Miamisburg to Germantown, Medway to New Carlisle, Hebron to Buckeye Lake, and Newark to Granville. The Schoepf properties in Ohio are now in three corporations, the Lima and Toledo including the northern Ohio lines, the Indiana, Columbus & Eastern—which is the Central Ohio lines, and the Cincinnati Northern, which runs from Cincinnati north to Dayton. It is these three corporations which, in financial circles, are believed will be taken over by the newly formed corporation under the name of the Ohio Electric Railway Company.

NEW INCORPORATIONS.

HARRISBURG, PA.—Conynham Valley Telephone Company, Wilkes-Barre. $20,000.

CONCORD, N. H.—Southern Coos Telephone Company, of Colebrook. $10,000.

GALENA, OKLA.—The Wild Cat Telephone Company. $2,500. Incorporators: John C. Corbin, M. S. English and F. String.

CARMEN, OKLA.—The Rich Valley Telephone Company. $1,000. Incorporators: A. G. Melrose, Ed. Hughes and Walter Milumn.

INDIANAPOLIS, IND.—Greenfield Light and Power Company, Greenfield. $25,000. Directors: R. S. Ashe, F. E. Barrett and C. E. Barrett.

WALLINGS STORE, OKLA.—The Whisket Creek Telephone Company. $5,000. Incorporators: C. M. Barnes, Ed. Owins and C. O. Hooper.

HARRISBURG, PA.—Deodate & Hershey Street Railway Company. To build a line in the lower end of Dauphin county. $30,000. President, M. S. Hershey, Lancaster.

JERSEY CITY, N. J.—Williamsport Light Company. To operate gas and electric plants. $500,000. Incorporators: Alfred Ely, Jacob Delmer and William H. Carey.

MINNEAPOLIS, MINN.—Union Hill Telephone Company, Union Hill. $8,000. Incorporators: C. A. Backman, Waterville; Joseph Widmer and E. M. Widmer, New Prague.

INDIANAPOLIS, IND.—Grayford & San Jacinto Telephone Company, of Jennings county. $300. Directors: A. E. Grimes, D. H. Ziegler, Joseph Rogers, Charles Heaton and O. M. Anderson.

OLYMPIA, WASH.—Panhandle Electric Railway and Power Company, of Spokane. $1,000,000. Incorporators: Thomas W. Payne, of Michigan; Amasa J. Smith, of Spokane; Andrew Coolin, of Idaho; Harry W. Wallace, of Spokane, and John R. Jones, of Hillyard.

ST. LOUIS, MO.—Tri-City Traction Company, with headquarters in Champaign, Ill. To construct and operate a railway from a point in or near Edwardsville to a point on the east bank of the Mississippi river and to points in or near Venice and East St. Louis. $1,000,000. Incorporators: Charles Zilly, B. E. Bramble, C. A. Wright, R. H. Watson, Jr., and George M. Mattis.

COLUMBUS, OHIO—The Fremont, Tiffin, Marion & Southern Interurban Railroad Company, of Tiffin. $10,000. Incorporators: Donald McKenzie, William H. Kildon, Alex Kiskadden, James D. Watson and W. W. Keller. The line proposed runs from Fremont through Sandusky county to Tiffin in Seneca county, and on to Marion, with the right to build such branches as may be desirable.

GUTHRIE, OKLA.—Texhoma Telephone Company, of Texhoma; $5,000; incorporators: I. J., T. E. and Gertrude Osborne. Spring Creek Telephone Company, of Cashion; $5,000; incorporators: A. Cornwell, George Seybert and C. C. Comforth. D. B. Mutual Telephone Company, of Tristoli; $2,000; incorporators: L. B. Porter, Pashepherda; J. A. Jones, Orion; Alfred Dorsett and C. M. Cagley, Tristoli.

PORTLAND, ORE.—Eugene & Eastern Railway Company. To build an electric line from Eugene to Springfield, and thence along the McKenzie river to Prineville. $1,000,000. Incorporators: Al. Welch and E. W. Hall, of the Willamette Valley Company; F. W. Waters, former mayor of Salem, and right of way agent for the Willamette Valley Electric Company, and James R. Thompson and Charles A. Hardy.

INDIANAPOLIS, IND.—Indiana & Michigan Electric Company, of South Bend. To furnish electric lights, power and heat for South Bend, Mishawaka, Elkhart, Bristol, Goshen, Laporte and Michigan City. The headquarters of the company will be at South Bend. $1,915,500. Directors: Charles A. Chapin, Henry K. Chapin, Harden L. Crawford, Fred L. Dennis, Charles B. Calvert, Homer C. Chapin, Marshall L. Howell, Fred A. Bryan and Richmond Talbot.

GUTHRIE, OKLA.—The Oklahoma City Electric Railway Terminal Association of Oklahoma City, Pittsburg, Pa., and New York. To build a standard gauge line, chiefly electric, from the south line of Capitol Hill north to and through Oklahoma City to the northwest boundary of the city; also a second line from the junction of the Rock Island and Frisco railroads, east of Oklahoma City, to and through the city to a point west of the city or near the intersection of Main street and North Canadian river. $1,000,000. Incorporators: Guy V. McClure, Warren Moore, Carlos and Fred Combs and J. J. Johnson, all of Oklahoma City.

COLUMBUS, OHIO—The Ohio Electric Railway Company, of Cincinnati. To own, construct and operate a line of electric railway running from Zanesville to the Indiana line near New Paris, Preble county, and extending thence to Richmond, Ind., Cincinnati, Columbus, Washington, Springfield, Toledo, Dayton, Defiance, Lima, Fort Wayne, and passing through Muskingum, Licking, Franklin, Madison, Clark, Greene, Montgomery, Preble, Hamilton, Butler, Warren, Champaign, Logan, Auglaize, Allen, Putnam, Defiance, Henry, Wood, Lucas, Pickaway, Fayette, Darke and Van Wert counties, Ohio. $100,000. Incorporators: E. H. Berry, D. J. Downing, S. M. Murray, W. H. Schubert and C. W. Wilson.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

International Independent Telephone Association. Chicago, Ill., June 4-6.

National Electric Light Association. Annual meeting, Washington, D. C., June 4, 5, 6 and 7.

American Railway Master Mechanics' Association. Annual meeting, Atlantic City, N. J., June 12-14.

Pacific Coast Electric Transmission Association. Los Angeles, Cal., June 18-20.

Association of Railway Telegraph Superintendents. Annual meeting, Norfolk, Va., June 19.

American Society for Testing Materials. Annual meeting, Atlantic City, N. J., June 20-22.

American Institute of Electrical Engineers. Annual meeting, Niagara Falls, N. Y., June 25-28.

New York State Street Railway Association. Annual meeting, Pine Bluff Point, N. Y., June 26-27.

Society for the Promotion of Engineering Education. Case School of Applied Science, Cleveland, Ohio, July 1-3.

National Electrical Contractors' Association. Annual meeting, New York city, July 17-19.

International Association of Municipal Electricians. Norfolk, Va., August 20-22.

Ohio Electric Light Association. Annual meeting, Toledo, Ohio, August 20-22.

NEW MANUFACTURING COMPANIES.

ST. LOUIS, MO.—The Gradolph Electric Company, with a capital of $100,000, has been incorporated by William F. Gradolph, Charles A. Neil, Joseph Zerr, E. A. Wiedemann and Mason K. Black. The company will manufacture and deal in electrical appliances.

ALBANY, N. Y.—The Electric Automatic Railroad Safety Signal Company, of New York, with a capital of $1,000,000, has been incorporated with the secretary of state. The directors are: Mark Birmingham, C. A. Reed, D. W. Birmingham, New York.

TOLEDO, OHIO—The Toledo Light and Equipment Company has been incorporated for the purpose of manufacturing an electric lamp with a reflecting globe. The capital of the new company is $100,000, and the following are the incorporators: William C. Miller, Douglas A. Howell, John E. J. Nicks, A. P. McArthur and A. A. Buck. The company has secured the sales agency for Ohio and expects in the future to erect a large plant in Toledo to manufacture the new light. The parent company has a plant in New Jersey, where the lamps are now made.

OBITUARY NOTE.

MR. JAMES D. PALMER, an inventor of electrical bath appliances, died at Willoughby, Ohio, on Thursday, May 16. Mr. Palmer was born in 1834 at North Adams, N. Y., and served with distinction among the Ohio volunteers in the civil war.

EDUCATIONAL NOTE.

GRADUATION EXERCISES, MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The graduation exercises of the class of 1907 of the Massachusetts Institute of Technology will be held in Huntington Hall, Rogers Building, No. 491 Boylston street, Boston, Mass., on Tuesday, June 4, at 2.30 o'clock. The buildings of the institute will be open to visitors immediately after the exercises. Professor H. E. Clifford, of the Electrical Engineering Department of the Massachusetts Institute of Technology, will next year extend his lectures on alternating currents into a graduate course. These lectures have hitherto been restricted to the required work in alternating currents of the undergraduate students, but during the next college year Professor Clifford will deliver an advanced course which will be particularly intended for graduate students who are attending the Institute for the purpose of spending a fifth year in the engineering school, or for the purpose of their obtaining a second degree.

ELECTRICAL SECURITIES.

With prophecy and every indication to the contrary the stock market was last week shaken out of its speculative rut and witnessed the sharpest break since the middle of last March. Prices made general declines, with some issues touching new low levels for the year. Short pressure was constantly exerted, with some of the large operators active on the short account, and, what is very surprising, very little support appeared from the banking interests, which, in the main, seemed recently to be fostering a rise in prices. Notwithstanding the declines, however, there seems to be a stability and lack of apprehension in the market that removes all fear of panic or collapse.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 25.

New York:	*Closing.*
Allis-Chalmers common	9½
Allis-Chalmers preferred	26
Brooklyn Rapid Transit	53
Consolidated Gas	120
General Electric	139
Interborough-Metropolitan common	19½
Interborough-Metropolitan preferred	53¾
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	68
Mackay Companies (Postal Telegraph and Cables) preferred	68
Manhattan Elevated	133
Metropolitan Street Railway	85
New York & New Jersey Telephone	112
Western Union	81½
Westinghouse Manufacturing Company	143

The guaranteed dividend of 1¾ per cent on the stock of the Metropolitan Street Railway Company for the current quarter is payable July 1. Books close June 20 and reopen July 2.

Fifty million dollars' worth of the preferred stock and $41,380,400 of the common stock of the Mackay companies has been listed on the London Stock Exchange.

The Brooklyn Union Elevated and Nassau Electric, subsidiaries of the Brooklyn Rapid Transit Company, will authorize a mortgage on behalf of the Brooklyn Union Elevated for $20,000,000 and one in behalf of the Nassau Electric for $5,000,000.

The report of the combined operations of the Interborough Rapid Transit and New York City Railway systems for the year ended March 31, 1907, shows a deficit of $1,347,489 as compared with a deficit of $2,341,878 in the preceding year. This is after allowing for the interest on the Interborough-Metropolitan bonds, 7 per cent on the outstanding Metropolitan Street Railway stock and 5 per cent on the Interborough-Metropolitan preferred. The balance of $926,501 is applicable to dividends on the 5 per cent cumulative preferred stock of the Interborough-Metropolitan company. The average amount of outstanding stock during the year was $45,479,800. On this basis the company earned only 2.04 per cent on the 5 per cent paid during the year. This resulted in a deficit of $1,347,489. The income account is as follows: Gross, $43,353,841; expenses, $21,841,884; net, $21,511,957; other income, $1,187,464; total income, $22,699,421; interest and rentals, $15,412,229; balance, $7,287,192; taxes (excluding Metropolitan franchise tax), $2,544,323; balance, $4,742,869; 4½ per cent on $70,000,000 Interborough-Metropolitan bonds, $3,150,000; applicable for dividends, $1,592,869; 7 per cent Metropolitan Street Railway stock, $666,368; balance, $926,501; 5 per cent Interborough-Metropolitan preferred, $2,273,990; deficit, $1,347,489. This compares with a deficit of $2,341,878 for the preceding year, a decrease of $994,389.

The Interborough-Metropolitan has decided to issue $15,000,000 6 per cent notes to run six months. Of this amount $3,000,000 worth has already been sold, which will be exchanged for three-year 5 per cent notes, when the 6 per cent notes mature. It is uncertain how many of the 6 per cent notes will be floated, but all will be exchanged into the 5 per cent notes at maturity. The security for these notes will be Metropolitan Street Railway three-year 6 per cent improvement notes to the amount of $8,000,000 to be issued; 59,700 shares of stock of the Third Avenue Railroad Company; 430 shares of the Forty-second Street & Grand Street Ferry stock; 5,028 shares of Central Crosstown Railroad stock; 1,507 shares of stock of the Second Avenue Railroad Company, and 6,955 shares of stock of the Electric Storage Battery Company. A portion of the proceeds from the sale of these notes is to be used to meet the cost of electrifying a number of the horse-car lines operated by the Metropolitan Street Railway Company.

Boston:	*Closing.*
American Telephone and Telegraph	121
Edison Electric Illuminating	212
Massachusetts Electric	59
New England Telephone	115
Western Telephone and Telegraph preferred	70

The fiscal year of the Edison Company of Boston ends June 30, and based on operations for the past ten months the annual report will show about 10 per cent increase in gross and 5 per cent increase in net. The net figures would have shown a larger increase but for the substantial reduction made in prices on July 1, 1906. The new business which the company has secured in the past four months is the largest in its history, representing an equivalent of 49,100 sixteen-candle-power lamps, compared with an increase in business for the corresponding period a year ago of 20,500 sixteen-candle-power lamps. The total connections on April 30, aggregated 1,478,750 sixteen-candle-power equivalents, compared with 1,444,363 sixteen-candle-power equivalents on June 30, 1906.

Philadelphia:	*Closing.*
Electric Company of America	9⅞
Electric Storage Battery common	50
Electric Storage Battery preferred	50
Philadelphia Electric	7⅞
Philadelphia Rapid Transit	23
United Gas Improvement	90⅞
Chicago:	*Closing.*
Chicago Telephone	120
Chicago Edison Light	140
Metropolitan Elevated preferred	64¾
National Carbon common	72
National Carbon preferred	112
Union Traction common	—
Union Traction preferred	—

The annual meeting of the Chicago Edison Company will be held June 10.

The directors of the Metropolitan Elevated Company have declared the regular quarterly dividend of ¾ of 1 per cent on the preferred stock, payable June 29. Books close June 22 and reopen June 29. This is the second dividend this year and since the resumption of dividend disbursements. The earnings of the road continue to show satisfactorily.

The deposits of traction securities were much more than sufficient except in the case of the Chicago West Division, which gave 3,126 shares, or exactly the number necessary, and the North Chicago City, which gave 1,251, or 53 less than necessary. North and West Chicago roads did well, averaging each 12,000 shares more than necessary.

ELECTRIC RAILWAYS.

OTTUMWA, IOWA—W. W. Cummings, of Ottumwa, has been awarded the contract for the grading of the new interurban road between Ottumwa and Hocking.

WASHINGTON, PA.—At a meeting of the directors of the Washington, Frederick & Gettysburg Railway Company the president was authorized to secure at once the right of way beyond Lewiston for the trolley line now building to Thurmont.

LAS VEGAS, N. M.—The assets of the Hot Springs Electric Railway, Light and Power Company have been sold at auction to the Las Vegas Railway and Power Company. The latter company owned about two-thirds of the stock of the defunct organization.

SAN DIEGO, CAL.—The South Park & East Side Electric Railway Company, of which E. Bartlett Webster is the principal owner, has been granted a franchise and right of way to run its line from the eastern boundary of the city of San Diego, along El Cajon avenue, and through La Mesa Springs and El Cajon.

SNOHOMISH, WASH.—Work on the new Snohomish-Seattle-Tacoma interurban line, which is eventually to grow into a line from Tacoma throughout the coast country to British Columbia, will be commenced here in a few weeks. Articles of incorporation of a construction company that will do the work have been filed.

COLUMBUS, OHIO—Officials of the Cleveland, Southwestern & Columbus Company, it is said, are now considering the feasibility of constructing a branch line to Medina from the west, probably at Wellington. The line from Wellington to Medina, as surveyed, is nineteen miles long, and runs through a thickly settled country.

PROVIDENCE, R. I.—The Rhode Island Company has completed plans for the $325,000 fireproof car-house to be erected on the site of the present South Providence car barns, which are to be dismantled. The proposed building is to be 700 feet long on Thurber's avenue, with frontages of 168 feet on both Broad street and Prairie avenue.

MAUCH CHUNK, PA.—At the annual meeting of the stockholders of the Carbon Street Railway Company the following officers and directors were elected for the ensuing year: officers—president, Hugh E. Crilley; vice-president, A. C. Godshall; secretary and treasurer, J. M. Dreisbach; directors—Hugh E. Crilley, A. S. Keck, H. C. Trexler, A. C. Godshall, T. A. Snyder and J. M. Dreisbach.

ST. PAUL, MINN.—The Minneapolis & Dubuque Electric Railway Company has filed articles of incorporation with the secretary of state. The capital stock is $50,000. The road, it is understood, has made a traffic arrangement with the Twin City Rapid Transit Company and cars will enter the twin cities over that corporation's tracks. It is believed that the Twin City company is behind the project.

SYRACUSE, N. Y.—It is reported in Syracuse that, with C. Loomis Allen, general superintendent of the Utica & Mohawk Valley Railway Company and general manager of the Syracuse Rapid Transit Company, as agent, the Andrews-Vanderbilt trolley syndicate is negotiating for the purchase of the Syracuse & Suburban Railroad, and it is thought that the road will soon pass into its control.

CENTRAL VILLAGE, CT.—Work on the new trolley line here has been completed. The new line is eighteen miles in length and passes through Plainfield, South Plainfield, Griswold near Hopeville, Clayville, Jewett City, Lisbon to Tafts, where the Willimantic and New London trolley is met. At this end, cars will connect for Putnam and Boston, Mass., and with electric lines for Providence, Boston and Worcester.

PANA, ILL.—At a meeting of the city council an ordinance was passed granting a franchise to the new Southeastern Illinois Traction Company, which is to be built from Springfield to Pana. The ordinance stipulates that the traction company is to commence the construction work within six months, and complete the road within two years or forfeit its franchise. The road will run from here to Springfield by way of Assumption and Taylorville.

JEFFERSON CITY, TENN.—A charter of incorporation has been applied for, granted and has been probated for the Jefferson City Electric Railway, Light and Power Company, capitalized at $15,000, the following officers appearing on the charter: W. T. Russell, F. W. Galbraith, J. B. Huff, A. A. Galbraith and J. T. Watkins. The object of the company is to furnish electricity for the operation of street cars, electric lights and for manufacturing industries.

AUGUSTA, ME.—The proposed location of the Augusta and Waterville electric road on the easterly side of the Kennebec river has been approved by the state board of railroad commissioners. Work of construction on the road, which will be about twenty-two miles long, will begin soon. The road is a part of a system to be completed this summer by the syndicate of which John R. Graham, of Bangor, is at the head and which includes the Lewiston, Brunswick & Bath electric road.

GREENSBORO, N. C.—W. T. Vanbrunt, Dee Allen and associates have purchased the Greensboro Electric Company. The company has a monopoly here of street-car service, electric lighting, gas and power plants. The new owners acquired some time ago the franchise for a railway from High Point to Greensboro, and have been at work constructing the line from High Point to connect with the company's steam road from Thomasville to Glendon. The plan is to connect Greensboro and High Point by electric road, and the purchase of the Greensboro plant makes the enterprise a certainty.

MEMPHIS, TENN.—The Alabama Land and Development Company, of Memphis, is preparing to build an electric line connecting Birmingham and Chattanooga, and has already begun the purchase of rights of way. It is proposed to carry the road through a section seriously in need of transportation facilities, and the route selected will run through Elrod's Hill, Crossville, Albertville and Lanamville. It is part of the plans of the company to dam certain streams on the route and generate by means of water power the electric current needed for operating the system. The site for one large power plant has already been secured.

ALBANY, N. Y.—The board of railroad commissioners has consented to the issuance by the Cortland County Traction Company of a first and refunding mortgage for $2,000,000, and approved of an increase of capital stock from $320,000 to $1,000,000. It is proposed to devote the increase of capital stock and the bonds to be issued to retire bonds outstanding under the first mortgage, to pay and discharge unsecured indebtedness of the traction company; to construct twenty-three miles of double suburban track and connect the existing railroad with the city of Syracuse; three miles of track in the city of Syracuse, and two miles in the city of Cortland, and such additional equipment and construction as is necessary in connection therewith.

LOS ANGELES, CAL.—A new electric railway line connecting Santa Ana with Newport Bay; a city at the new tidewater harbor to be called Port Orange; extensive terminal facilities and improvements contemplating connection with the three transcontinental lines, and the early opening of a free harbor, are planned by the articles of incorporation of the Port Orange & Santa Ana Railway Company. The incorporators of the company are Frank F. Johnson, Walter G. Hopkins, A. F. Lijeal, Joseph M. Fletcher, Eugene Germain, Marc L. Germain, C. L. Fredericks, Harry P. Vandeveer and G. H. McCarthy. The capital stock is $500,000 and the amount subscribed is $50,000. It will be a broad-gauge electric line and will be the last connecting rail link between the sea and a population of 150,000, exclusive of Los Angeles, distributed throughout the various cities of southern California. Much of the material for the new railway has already been purchased and work is to commence at once.

FREDERICK, MD.—There has been placed on record in the office of the clerk of the circuit court for Frederick county a deed of trust made by the Washington, Frederick & Gettysburg Railway Company to the Baltimore Trust and Guarantee Company, which latter corporation becomes the trustee for $400,000 first mortgage five per cent bonds, which were authorized by the stockholders of the railway company a short time ago. The bonds will bear date May 1, 1907, and will run for thirty years. Under the mortgage the railway company will be required to create a sinking fund, and the bonds will be redeemable at the pleasure of the company at $105. The mortgage covers the entire line of the road from a point on the District of Columbia line to the Pennsylvania line, a few miles beyond Emmitsburg, and all the franchises of the company. The bond issue, together with the subscribed stock, will be used to build and equip that portion of the road which is now under construction and extends from Frederick, through Yellow Springs, Lewistown, Catoctin Furnace and Thurmont to Emmitsburg, a distance of about twenty-four miles.

TELEPHONE AND TELEGRAPH.

PORTLAND, ME.—A new telephone company has been formed at Brooks and Monroe.

LESLIE, ARK.—The Farmers' Telephone Company has completed its line from Leslie to Marshall.

KANSAS CITY, MO.—The Missouri & Kansas Telephone Company has been granted a franchise to operate in Grain Valley.

EMAUS, PA.—The automatic branch telephone exchange has been put into service. It connects with the exchange in Allentown

KEOKUK, IOWA—The Mississippi Valley Telephone Company will erect a new building on plans by E. H. Ratcliffe, architect, to cost $7,800.

BAY CITY, MICH.—The Michigan State Telephone Company has started the work of building new lines and rebuilding old ones between Bay City and Saginaw. This will cost $10,000.

ST. JOHN, NEW BRUNSWICK—The directors of the New Brunswick Telephone Company have completed the details of the merger of the New Brunswick and Central Telephone companies.

BAY CITY, MICH.—The Northeastern Telegraph and Telephone Company, extending from Bay City to Alpena, is putting up two more wires north of the city to enable it to handle its increasing business.

LANSING, MICH.—The city council has passed an ordinance granting the Citizens' Telephone Company a new franchise and allowing the company to increase its rates. In consideration of this the company has agreed to install an automatic system.

SALT LAKE CITY, UTAH—The Bell Telephone Company has completed a new circuit between Missoula, Mont., and Wallace, Ida., which was made necessary by the heavy growth of business between Montana and the Cœur d'Alene and the eastern Washington region.

CORNWALL, ONTARIO—A new telephone company has been formed, called the Glengarry Telephone Company, with Donald McCaskill, of Laggan, as president. It is the company's intention to build a telephone line between Alexandria and points east and west.

BEAUMONT, TEX.—A deal has been completed whereby the Phœnix Telephone and Telegraph Company, extending from Sherman, Tex., to Honey Grove, a distance of forty-two miles, has been transferred from W. S. Tyrrell and Henry D. Keith, of Beaumont, to B. S. Young, of Ada, Ohio. The system will be improved.

NASHVILLE, TENN.—The Cumberland Telephone and Telegraph Company reports gross earnings for March of $474,980, an increase of $42,772, and net of $150,814, an increase of $17,576. From January 1 to March 31 the company earned $1,438,551 gross, an increase of $136,816, and $439,390 net, an increase of $25,782.

SPOKANE, WASH.—Officers of the Home Telephone Company announce that the new Spokane concern has no connection with the Home companies of California, except by long-distance arrangement. For the state of Washington the Empire Electric Company has been formed to construct the lines of the Home company. Robert Tucker is president of the electric company.

RUTLAND, VT.—The Mount Holly Telephone Company has been reorganized with the following officers: president, B. E. Horton; vice-president, I. L. Hill; secretary, Howland Marshall; assistant secretary, E. S. Burton; treasurer, J. D. S. Packer; directors, A. E. Hammond, W. H. White, and Fred White. It is expected the line will soon be extended to Tarbelville and East Wallingford.

ST. ALBANS, VT.—At the annual meeting of the Rutland County Telephone and Telegraph Company, held in Middletown Springs, the following officers were elected: president and general manager, A. W. Foote, of Middlebury; vice-president and treasurer, W. E. Grover, of Middletown Springs; secretary, D. S. Carpenter; directors: J. E. Buxton, W. E. Grover and D. S. Carpenter, of Middletown Springs; W. F. Otis, of Danby; E. M. Brown, of Pawlet, and A. W. Foote, of Middlebury.

BARRIE, ONTARIO—The town council has passed a by-law confirming an agreement with the Bell Telephone Company, giving it an exclusive franchise for five years, dating back to April 1, 1906. In exchange for this the company pays an annual rental of $300 and gives four free telephones, in addition to the usual taxation. During this period the rates must not exceed $25 for business telephones and $20 for residences, the same rates being charged throughout the town irrespective of the distance from the central office. Previous to this subscribers more than a mile from the central office paid an additional $8 a year.

READING, PA.—The charter of the Mountain Telephone Company has been received. The enterprise is capitalized at $5,000, with these incorporators: Harvey W. Kemp, of Landis Store; Owen K. Schultz, Horace F. Tyson and Samuel B. Latshaw, of Barto, and Adam L. Mensch, of Huff's Church. The new line will be connected with the Boyertown exchange of the Pennsylvania Telephone Company and will extend through parts of Berks, Montgomery and Lehigh counties, covering a distance of thirty-four miles. The line will pass through New Berlinville, Eshbach, Barto, Dale, Store, Henningsville, Longswamp, Stauffer's Mill, Huff's Church, Hill Church, Shamrock, Bally, Fredericksville, Congo, Sassamansville and other points.

TOLEDO, OHIO—The Central Union Telephone Company has awarded the contract to W. W. Bright for the erection of its new exchange on Hicks street, and ground has been broken for the building, which will cost about $30,000. The company will have five branch exchanges and one central exchange in Toledo when its plans are carried out. The Delaware avenue exchange is about completed and will be in operation July 1. The exchange at Hicks street will open for business on September 1, and the Superior street exchange in lower town will be opened in the spring of 1908. The East Toledo exchange has been in operation for several years. The Central Union Telephone Company will spend over $100,000 in Toledo for these new exchanges.

PERSONAL MENTION.

MR. WILLIAM B. REES, manager of the lighting and power department of the Syracuse (N. Y.) Lighting Company, which was recently absorbed by the United Gas Improvement Company, will resign on June 1.

MR. JOHN POWERS, superintendent of the Sterling, Dixon & Eastern Electric Railway, in the state of Illinois, has resigned and will take charge of the Galesburg plant of the McKinley syndicate.

MR. UDOLPHO SNEAD, president of the Louisville Gas Company and also of the Louisville Lighting Company, has resigned the presidency of both corporations. Both resignations will take effect immediately. F. M. Sackett, an attorney and member of the directorate of both Kentucky corporations, will succeed Mr. Snead in both capacities.

MR. PHILIP BARNHARD, Jr., of Lexington, Ky., has been appointed general manager and assistant secretary of the Tuscarawas County Electric Light and Power Company, at New Philadelphia, Ohio. Mr. Barnhard was formerly the general superintendent of the traction lines running into Lexington. After the absorption of the traction lines by the Lexington Street Railway Company, Mr. Barnhard was given a position with the savings department of the Third National Bank.

DR. BENJAMIN IDE WHEELER, president of the University of California, has been invited to accept the presidency of the Massachusetts Institute of Technology. Dr. Wheeler was born in Massachusetts, in Randolph county, July 15, 1854. He received his earlier education in the schools of Haverhill and Saco, completing his preparatory training at Colby Academy. He entered Brown University in 1871, and at the time of his graduation, in 1875, was class orator. From 1875 to 1879 he was teacher in the classical department of the Providence (R. I.) High School, and for the next two years in Brown. The next three years were spent abroad. He received the degree of Ph.D. at Heidelburg. Dr. Wheeler was appointed instructor at Harvard, and a year later, in 1886, was elected professor of comparative philiogy at Cornell. In 1896 he was appointed professor of Greek in the American School of Classical Studies at Athens, and in 1899 became the head of the University of California.

ELECTRIC LIGHTING.

FREDERICKSBURG, TEX.—The present electric light plant is to be enlarged and many improvements inaugurated.

BOWLING GREEN, KY.—The Green River Hydroelectric Company, organized some time ago with a capitalization of $150,000, has begun work on its system at Glenmore.

SPARTANBURG, S. C.—The Electric Manufacturing and Power Company is considering the development of Nesbitt's shoals, on Tyger river, where it may erect a large electric light plant.

MOUNT PLEASANT, MICH.—The Mount Pleasant Electric Light Company has sold the lighting plant to E. O. Harris, head of the Harris Milling Company, of Mount Pleasant. The consideration was $13,000.

VERSAILLES, KY.—The Versailles Electric Light Company, composed of Pennsylvania capitalists, represented by Edward Gunster, of Wilkes-Barre, has sold its electric light plant here to Harry Reid, formerly of New York.

ALBANY, N. Y.—The state gas commission has denied the application of the West Shore Electric Company for a certificate of authority to install an electric lighting plant at Coeymans and to furnish electric service in Ravena and in the village of New Baltimore.

WAPAKONETA, OHIO—The village council of Cridersville has sold the electric light plant and a five-acre tract, including several factory buildings, to a number of Lima capitalists connected with the Fort Wayne, Van Wert & Lima Traction Company, the highest bidders.

DETROIT, MICH.—Under the terms of the contract made by the village of Fairview with the Edison Illuminating Company, Detroit, it will be required to pay that company $67.50 per arc lamp for the lights in that village until January 1, 1912. The village now has forty-four lamps furnished by the Edison company.

RUSSELLVILLE, ARK.—The city council has granted a franchise to the Southern Traction and Power Company, of Pine Bluff, authorizing this company to furnish electric lights to the town and a system of waterworks. The company proposes to build a concrete dam at Cagles' mills, about six miles from town, which will furnish the necessary power.

BRISTOL, VA.—It is proposed to develop 4,000 horse-power at the fish dam on the Holston river, ten miles from Bristol, Tenn., and distribute the electricity for power and lighting purposes. Charles Hall Davis and associates, of Petersburg, Va., have submitted to the city of Bristol, through their engineers, Charles Hansel & Company, of New York, a proposition to build the plant.

STOCKTON, CAL.—The American River Electric Company has commenced work on a large auxiliary electric plant which will be located on the north bank of the Stockton channel and cost about $250,000. The main building will be of reinforced concrete and steel, and high-pressure machinery will be placed in position to supply current when the plant on the American river is out of commission.

GREAT FALLS, S. C.—Announcement has been made that work has been resumed by the Southern Power Company at the Rocky Creek Station, a short distance below Great Falls. More than 200 men are now employed. The development at Ninety-nine Islands, on the Broad river, moves on apace. The railroad will soon be completed which will permit the heavy machinery necessary to be brought to the site of the plant.

DELAWARE, OHIO—The stockholders of the Delaware Electric Light, Heat and Power Company at their annual meeting elected the following directors: Dr. A. J. Lyon, Adolf Frank, M. Miller, J. G. Rosenthal, T. J. Griffin, W. F. Dodge, B. F. Freshwater, James Wilson and J. E. Campbell. The directors organized as follows: president, Dr. A. J. Lyon; vice-president, A. Frank; treasurer, M. Miller; secretary, J. G. Rosenthal.

WICHITA, KAN.—The Wichita Electric Light and Power Company has made a twenty-five per cent reduction in its rates for light and power, which is in accordance with the terms of its new thirty-year franchise granted by the city. Further reductions are to be made each year for the first five years, which will ultimately make the net rate about thirty-three per cent less than under the old franchise. The company is expending $75,000 in new machinery and reconstruction of lines.

HOLLAND, MICH.—The municipal electric light and water plants during the past year yielded a net profit of $5,686.57, of which amount $3,337.69 is credited to the light plant and $2,348.88 was realized from the water plant. The present combined valuation is $219,550.05, of which amount $84,904.70 is invested in the light plant and $134,645.35 in the water plant. The bonded indebtedness is: light, $49,000; water, $80,000. Light is furnished at eight and one-third cents per kilowatt-hour.

SPARTANBURG, S. C.—The Broad River Power Company, of Elberton, Ga., has been incorporated by A. S. J. Stovall, E. B. Tate, I. G. Swift, A. S. Oliver and associates. The company proposes to develop water powers on the Broad, South Broad and North Broad rivers for electrical purposes, and expects to obtain 15,000 horse-power. Elberton, Bowman, Comer, Royston, Carlton and Athens, Ga., are to be furnished current for power and lighting purposes. The company has a capital stock of $250,000, and $50,000 is said to have been paid in.

WHITESBORO, N. Y.—The town board has granted a franchise to the Oriskany Hydroelectric Company to generate electricity on the Oriskany creek, at Pleasant Valley, near Summit Park. The company contemplates the erection of a power plant that will involve an expenditure estimated at $300,000. The plant will be located at the site of the old Oriskany Woolen Manufacturing Company, an option on which property has been secured, together with hundreds of acres of land in the vicinity. The old dam will be rebuilt and it is expected that work on the power station will be commenced next fall. The company proposes to sell electricity for power and illuminating purposes to the villages along the valley from here to Norwich.

PROVIDENCE, R. I.—The control of the Woonsocket Electric Machine and Power Company has passed from the citizens of Woonsocket, who organized it and built it to its present proportions, to the stockbrokers' firm of Estabrook & Company, of Boston, which is said to represent the Sayles interests, of Pawtucket, which already owns the Woonsocket Gas Company as well as the lighting plants of the towns and cities between Woonsocket and Providence. The price paid per share was $155.15, less the amount caused by the defalcation of the defaulting treasurer, Levi C. Lincoln. The directors of the company, at the suggestion of Estabrook & Company, elected N. P. Wilcox, of Medfield, general manager of the company in Woonsocket. E. P. Allen, of Somerville, Mass., was elected treasurer.

BLUFFTON, IND.—The Marion, Bluffton & Eastern Traction Company has made a proposal to the city council to furnish the city electric current at ten per cent less than it is now costing the city to manufacture it, the cost to be determined by a committee consisting of one councilman, one member of the traction company and the third to be selected by the other two. The company also agreed to run lines to factories in the city not now connected with the city plant. Should the proposal be accepted, it would mean the abandonment of the city's electric light plant and the retention of its poles, wires and transformers, the city to buy the current at wholesale, to be sold at retail. The Marion, Bluffton & Eastern Company buys its power from the Marion Heating and Lighting Company, a branch of the American Electric and Power Company.

ENGINEERING SOCIETY NOTE.

SCHENECTADY BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The annual meeting of the Schenectady (N. Y.) branch of the American Institute of Electrical Engineers was held on May 23, about 500 members being present. The report of the treasurer showed the total receipts for the year to be $1,200, with a balance on hand of $773.88. The secretary's report showed an increase in membership from 200 to more than 900 during the year. Nearly all the old officers were reelected, as follows: honorary chairman, Dr. C. P. Steinmetz; chairman, D. B. Rushmore; vice-chairmen, E. H. Anderson, A. H. Armstrong, E. A. Baldwin, E. E. F. Creighton, William Dalton, G. H. Hill, E. B. Merriam, A. L. Rohrer and C. W. Stone; corresponding secretary, W. C. Andrews; recording secretary, J. M. Knox; treasurer, A. S. Kappella; librarian, H. E. White.

INDUSTRIAL ITEMS.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, Hartford, Ct., will have an exhibit of Franklin, Gem, tantalum and standard lamps in space 2 in connection with the convention of the National Electric Light Association, which will be held at Washington next week.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., in catalogue No. 19, describes and illustrates enclosed fuses and blocks, open-link fuses and tested fuse wire. This catalogue is very handsome in appearance, and is copiously illustrated and replete with interesting and practical information concerning "Union" fuse protecting material for every kind of electrical service.

THE GUY V. WILLIAMS COMPANY, Granite Building, St. Louis, Mo., has been organized to take over the business of the Williams & Bernhard Company. This company will act as agents in St. Louis and the Southwest for the following companies: American Instrument Company, the Bristol Company, Switchboard Equipment Company, Collyer Insulated Wire Company, the Phelps Company, Lincoln Motor Works and C. J. Toerring Company. Mr. Guy V. Williams, who has been prominently identified with the incandescent lamp industry, is president of this new company.

V. C. GILPIN, 120 Liberty street, New York city, has taken the agency for New York, New Jersey and eastern Pennsylvania for the flexible conduit manufactured by the Alphaduct Company. Mr. Gilpin's office also acts as an agency for the following: American Conduit Manufacturing Company, manufacturer of enameled steel conduit; Scranton Button Company, manufacturer of moulded electrical fittings; Steel City Electric Company, manufacturer of "Star" bushings, locknuts, etc., and the Sterling Electric Company, manufacturer of flexible steel conduit and armored conductor.

THE WESCO SUPPLY COMPANY, Fort Worth, Tex., and St. Louis, Mo., importer and jobber of electrical machinery and supplies, announces the establishment of a new branch office at Birmingham, Ala. This office will be in charge by W. W. Moore, who for several years has managed the apparatus department of the company with headquarters at St. Louis. Mr. Moore is a native of the South and is a capable and well-posted man in this particular branch of the electrical business, and his wide acquaintance and many friends in that section assure the company in advance of an extensive and profitable patronage through its newly established office.

THE G. I. INCANDESCENT LAMP COMPANY, Cleveland, Ohio, whose main office and factory are located at 1811 East Forty-fifth street, has appointed the W. F. Irish Electric Company, 60 Cortlandt street, New York city, as its special representatives for New York and vicinity. In future this company will carry in stock at New York, incandescent lamps of the G. I. type for all voltages, circuits and conditions, and can take care of all orders for this line promptly from stock. The G. I. company recently secured the largest single installation of GEM lamps in the world, this installation being the new Pierce Building, St. Louis, Mo. In this building there are 7,614 sockets; 6,000 of these sockets contain fifty-watt twenty-candle-power G. I. GEM incandescent lamps; 1,014 in the lobbies contain fifty-candle-power G. I. GEM high-efficiency units.

Record of Electrical Patents.

Week of May 21.

853,989. VACUUM-TUBE LAMP. Daniel M. Moore, Newark, N. J., assignor to Moore Electrical Company, New York, N. Y. The tube is filled with electrically treated hydro-benzamid.

853,990. AUTOMATIC ELECTRICAL CUTOFF. Robert H. McDowell, Alliance, Ohio, assignor to the Electric Filter Company, Alliance, Ohio. A combined water faucet and switch.

854,013. DANGER SIGNAL FOR PORTABLE ELECTRIC TOOLS. James I. Ayer, Cambridgeport, Mass., assignor to Simplex Electric Heating Company, Boston, Mass. A small lamp indicates when the current is turned on.

854,015. LIMIT-SWITCH. George Baehr, McKeesport, Pa., assignor to Electric Controller and Supply Company, Cleveland, Ohio. A motion-limiting device for reversing controllers.

854,020. BRANCH CONDUIT BOX FOR ELECTRIC WIRES. Leon W. Bossert, Utica, N. Y. The box is subdivided into compartments.

854,025. TELEPHONE TRANSMITTER. Ralph C. Browne, Salem, Mass., assignor to John Abbott, Winchester, Mass. The granular conductor is held between movable non-conducting walls.

854,028. ELECTRIC WOOL WASHING AND CLEANSING APPARATUS. George D. Burton, Boston, Mass., assignor to American Electrical Process Company, Boston, Mass. The current from a number of electrodes is passed through the vat.

854,039. COMMUTATOR-SWITCH. Edward B. Jacobson, Pittsfield, Mass., assignor to Pittsfield Spark-Coil Company, Pittsfield, Mass. A battery switch.

854,050. ELECTRICAL DRIVING MECHANISM. Gustave C. Marx, Elizabeth, N. J., assignor to Diehl Manufacturing Company. A motor fitted with a friction clutch.

854,072. ELECTRIC-LIGHTING SYSTEM FOR RAILWAY CARS. William J. Bohan, St. Paul, Minn. A train-lighting system.

854,076. PHOTOGRAPHIC-PRINTING MACHINE. Joseph C. Calhoun, Holland, Mich., assignor of one-half to George P. Hummer, Grand Rapids, Mich. The lamps are controlled by a clock.

854,094. ELECTRICAL CONDUCTOR AND ARMOR THEREFOR. Charles J. Klein, New York, N. Y., assignor to Ralph Abraham Schoenberg, New York, N. Y. A combination of a plurality of electrical conductors and a plurality of flattened longitudinally-tapering, open-ended armoring members, the end portion of one fitting into a larger end portion of another.

854,104. VACUUM-TUBE LAMP. Daniel M. Moore, Newark, N. J., assignor to Moore Electrical Company, New York, N. Y. A vacuum tube lamp containing graphitic acid.

854,107. MAGNETIC CLUTCH. Alfred Pick, Yonkers, N. Y., assignor of fifteen one-hundredths to William W. Butler, Yonkers, N. Y. A magnet having an unhomogeneous magnetic circuit.

854,120. DEVICE FOR AMPLIFYING ELECTRICAL CURRENTS. John S. Stone, Cambridge, Mass., assignor to John A. Chrystie, Louis Duncan and Walter H. Turner, New York, N. Y. A michrophonic transmitter, magnetically controlled.

854,121. SYSTEM OF ELECTRICAL DISTRIBUTION. Simon B. Storer, Syracuse, N. Y. An electrical balance is established by a regulator having resistances of different temperature coefficients.

854,122. SYSTEM OF ELECTRICAL DISTRIBUTION. Simon B. Storer, Syracuse, N. Y. A device for operating electric regulators.

854,123. VOLTAGE REGULATOR. Simon B. Storer, Syracuse, N. Y. Automatic means are provided for controlling the connections of two transformers.

854,153. ELECTROMAGNETIC MEANS FOR TRANSPORTING NON-MAGNETIC MATERIALS. Ethan I. Dodds, Pullman, Ill. A transporting magnet.

854,164. AUTOMATIC SWITCH FOR TELEPHONE INSTALLATIONS. Paul Hildebrand, Munich, Germany. An automatic system.

854,177. ELECTRIC GAS LIGHTER. Edmund H. Pryce, Yonkers, N. Y. A magneto igniter.

854,203. TELEPHONE EXCHANGE APPARATUS. Claude D. Enochs, La Crosse, Wis., assignor to the Vote-Berger Company. An automatic steadying resistance is used.

854,204. TELEPHONE EXCHANGE APPARATUS. Claude D. Enochs, La Crosse, Wis., assignor to the Vote-Berger Company. A ballast is placed in circuit with the signal.

854,205. CIRCUIT-CLOSING DEVICE. Frederic W. Erickson, New York, N. Y. A push-button.

854,272. HEAT COIL. Frank B. Cook, Chicago, Ill. A fuse.

854,277. MEANS FOR COOLING TRANSFORMERS. Frederick Darlington, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The transformer case is submerged in a tank containing a liquid having high specific heat.

854,278. RADIATOR. Frederick Darlington, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. Sealed tubes, containing a volatile fluid, project from the cooling fluid.

854,279. TELEPHONE EXCHANGE SYSTEM. William W. Dean, Elyria, Ohio, assignor to the Dean Electric Company, Elyria, Ohio. A central energy system.

854,300. VACUUM-TUBE ELECTRIC APPARATUS. Daniel McF. Moore, Newark, N. J., assignor to Moore Electrical Company, New York, N. Y. A vacuum regulating valve.

854,309. SUPPORTING MEANS FOR ELECTRIC APPARATUS. Emerson G. Reed, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An adjustable support for transformers.

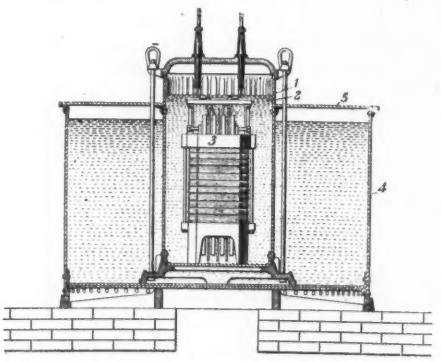
854,311. TRANSFORMER COIL SUPPORT. Charles E. Skinner, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. An extensible frame for supporting transformer coils.

854,312. MEANS FOR COOLING TRANSFORMERS. Charles E. Skinner, Wilkinsburg, and Samuel M. Kintner, Pittsburg, Pa., assignors to Westinghouse Electric and Manufacturing Company. Streams of cooled liquid are forced through the transformer.

854,315. INSULATOR. Henry D. Stauffer, Oregon, Ill. A split insulator.

854,316. ELECTRICAL APPARATUS. Wilbur H. Thompson, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. A number of independent secondaries associated with one primary coil.

854,326. BATTERY PLATE AND PROCESS OF MAKING SAME. Joseph Bijur, New York, N. Y., assignor to the General Storage Battery Company. The active portions are connected to the grid at a few points.



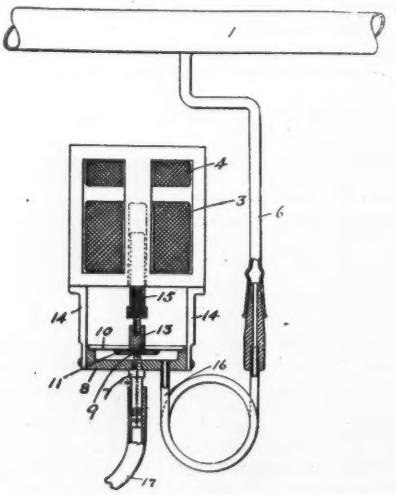
854,277 — MEANS FOR COOLING TRANSFORMERS.

854,327. INDICATING MECHANISM FOR ELECTRIC FUSES OR CUTOUTS. Leonard B. Buchanan, Woburn, Mass. An indicator for an enclosed fuse.

854,328. RAIL BOND PROTECTQR. Leonard B. Buchanan, Woburn, Mass. A shield for protecting rail bonds.

854,337. TRUNK LINE TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Employs a third conductor for signaling.

854,344. ELECTRICAL SIGNALING APPARATUS FOR ENGINES. George J. Exterkamp, Covington, Ky., assignor of one-half to John A. Thobe, Covington, Ky. A track signaling system.



854,300.—VACUUM-TUBE ELECTRIC APPARATUS.

854,362. GENERATION AND DISTRIBUTION OF ENERGY. John F. Kelly, Pittsfield, Mass. An alternator excited by alternating currents.

854,369. RECEPTACLE AND PLUG FOR ELECTRICAL CONNECTIONS. Walter S. Mayer, Philadelphia, Pa., assignor to the Machen & Mayer Electrical Manufacturing Company, Philadelphia, Pa. A method of construction.

854,389. METHOD OF CASTING TROLLEY WHEELS. Francis B. Torrey, Portland, Me. A composite wheel.

854,401. TELEGRAPH TRANSMITTER. John Burry, Ridgefield Park, N. J. A telegraph key.

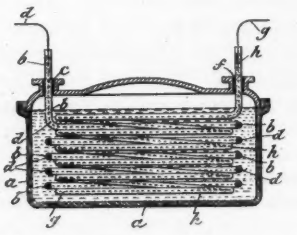
854,421. MAGNETO-ARMATURE. Theodore Hubert, New York, N. Y., assignor to Charles F. Splitdorf, New York, N. Y. Flanges of insulating material project over the windings.

854,425. DYNAMOELECTRIC MACHINE WITH COMMUTATING POLES. Henry R. King, Hinsdale, Ill., assignor to Western Electric Company, Chicago, Ill. A direct-current dynamo with compensating windings.

854,431. PRESS OR SAD IRON. James B. Replogle, Chicago, Ill. A magnetizing coil is enclosed within the iron.

854,436. ELECTRICAL SWITCH. William M. Scott, Philadelphia, Pa., assignor to the Cutter Electrical and Manufacturing Company, Philadelphia, Pa. A switch operated by a double toggle.

854,438. MAGNETO-ARMATURE. Charles F. Splitdorf, New York, N. Y. The armature heads have projections extending between the windings.



854,662.—ELECTRICAL CONDENSER.

854,439. PORTABLE COMBINATION TELEPHONE SET. Alfred Stromberg, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A hand telephone.

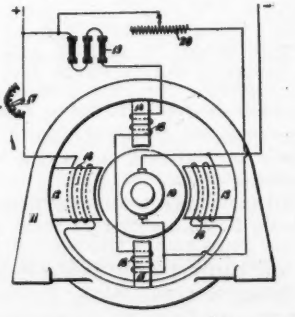
854,455. LOCK FOR ELECTRIC SWITCHES. Frank W. Brandow, Pittsfield, Mass. A lock for igniter switches.

854,489. TROLLEY POLE SUPPORT. John Gribben, Sharpsburg, Pa., assignor of one-half to David J. Morgan, Pittsburg, Pa. A post over which the supporting pole may be slipped.

854,493. CLUSTER SOCKET. Gustav A. Harter, Chicago, Ill. The body is of plastic insulating material.

854,543. PARTY-LINE TELEPHONE SYSTEM. Guy E. Terhune, William M. Eidson and William B. Huston, Willow Hill, Ill. Electrically operated means are provided for indicating a busy line.

854,552. TELEPHONE SWITCH. James S. Alsobrook, Wood Station, Ga. A hook switch.



854,704.—DYNAMOELECTRIC MACHINE.

854,554. ELECTRIC LIGHT FIXTURE. John F. Barrett, Chicago, Ill. A tubular fixture.

854,562. ELECTRIC CONDUCTOR OR CABLE. Sidney G. Brown, London, England. A copper conductor associated with a magnetic conductor of segmental form.

854,662. ELECTRIC CONDENSER. Ignacy Moscicki, Fribourg, Switzerland. An electrolytic condenser.

854,704. DYNAMOELECTRIC MACHINE. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. Commutating poles are provided.